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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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REVIEWS AND OUR BOOKSHELF.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

THURSDAY, MARCH 3, 1910.

N ENCYCLOPÆDIC TREATISE ON THE PROTOZOA.

ehrbuch der Protozoenkunde. Zweite Auflage der "Protozoen als Parasiten und Krankheitserreger." By Dr. F. Doflein. Pp. x+914; 825 figures. (Jena: Gustav Fischer, 1909.) Price 24 marks (unbound).

THE study of the Protozoa has made very great progress during the last twenty years, so great at even those who devote themselves to this branch knowledge have the utmost difficulty in keeping ce with its rapid advance. This state of things is e chiefly to the great practical importance of the otozoa for medical, veterinary, and agricultural ience, but also because the primitive forms of life ve the clue to many biological problems of fundaental importance. Hence the number of those who cupy themselves with researches upon Protozoa has ry much increased, both amongst professed zoolosts and also amongst those to whom zoological estions are a secondary consideration; all such rkers, however, whatever their aims, will welcome e publication of Prof. Doflein's treatise. This work ostensibly the second edition of his well-known anual on the Protozoa as parasites and causes of sease, a most useful book in its time, though now t behind by the flowing tide of research; its parentge, however, is scarcely recognisable, since the cond edition appears with new title, changed form, d greatly enlarged scope. The treatment of paraes and disease, though not neglected, takes a condary place, and the work has become an exustive general treatise on the Protozoa.

It is difficult, within the limits of space imposed on a reviewer, to give an adequate account of the ealth of facts, ideas, and illustrations contained in e 900 or so pages of this book. The work is vided into two halves, the first containing a general count of the natural history of the Protozoa, the cond a more detailed systematic description of the oups of Protozoa and of the special problems conected with them.

The general part begins with a short introduction giving the definition and distinctive characters of the Protozoa, and is then subdivided under the headings morphology, physiology, reproduction, biology (or bionomics), system, and technique. The Protozoa are regarded as unicellular organisms occupying a middle position between the Bacteria and their allies below and the Metazoa above. As regards the structure of protoplasm, the author is a strong adherent of the alveolar theory of Bütschli. The nucleus of Protozoa is described in detail, both as regards constitution and morphology, and special sections are devoted to chromidia, centrosomes, and blepharoplasts; we miss, however, any discussion of the binuclear hypothesis of the cell, put forward by Hartmann and Prowazek, in relation to the theory of the centrosome. The term "blepharoplast" is applied by the author to the kinetonucleus of trypanosomes, as is usual in Germany; we must confess to a feeling of surprise, however, that the author doubts the nuclear nature of this body.

The section on physiology is subdivided under the headings "Stoffwechsel" and "Kraftwechsel." The section on reproduction deals with fission, fertilisation, form and development, the Protozoa as unicellular organisms, and theoretical problems of sex and reproduction. Under the fifth of these headings the author discusses the hypothesis of nuclear dualism (more correctly dualism of the chromatin-substance) of the protozoan organism put forward by Schaudinn and Goldschmidt; according to this view, every protozoon is be regarded as containing two nuclei (or rather two kinds of chromatin), a "Stoffwechselkern" of vegetative somatochromatin, and a "Geschlechtskern" of generative idiochromatin. The author considers (and we fully agree) that there are not two distinct kinds of nuclear substance, but that one and the same substance is responsible both for functional activity and for heredity in the protozoan body; he quotes Hertwig's opinion in support of his own, to the effect that somatochromatin is idiochromatin of which the activities are awakened, and idiochromatin is somatochromatin in which the activity is dormant but can be renewed under suitable conditions. He considers,

further, that many substances, which have been mistaken for chromatin on account of their affinity for stains, are in reality reserve materials, precipitation-products, and the like, and that this confusion of chromatin with other substances has often led to the erroneous distinction of two kinds of chromatin.

In discussing the theoretical aspects of reproduction and fertilisation, the author states and reviews in a very clear and interesting manner the various theories that have been put forward, especially those of Weismann, Bütschli, Hertwig, and Schaudinn, and ends by sketching in brief outline a theory of his own. Living cells are regarded as consisting principally of two groups of vitally-active substances, the one, more fluid, responsible for motor phenomena, the other, more viscid, regulating metabolic cell-functions. In cell-reproduction by fission these substances are never distributed with mathematical equality amongst the descendants, hence continued division brings about accumulations of different properties in certain individuals, with, as a consequence, impaired vital activity and reproductive power. Individuals are produced, some of which become richer in reserve material (female), others in motile substance (male). Since these two kinds of individuals contain aggregations of substances which have intense mutual chemical reactions, they exert an attraction one towards the other; the two individuals tend to unite as gametes, and by their union cell-equilibrium is restored and vital powers renewed. Hence fertilisation is regarded as a necessity for the life-cycle, due primarily to the imperfections of cell-division and to the consequent loss of equilibrium in the cell-constituents, a view which unites and extends the theories of Schaudinn and Hertwig respectively.

The section dealing with the bionomics of the Protozoa is divided into the following subsections:—occurrence and distribution, habit and mode of life, adaptation of the methods of nutrition, adaptations of the reproductive processes and means of dispersal, influence of the medium, light and rays, temperature and climate. Under the heading "System," the various classifications that have been put forward are discussed. The Protozoa are classified into two main divisions, first, the Plasmodroma, including the Rhizopoda, Mastigophora, and Sporozoa; and, secondly, the Ciliophora, including the Ciliata and Suctoria. The Spirochætes are regarded as leading from the organisms of bacterial nature to Mastigophora, and hence, for the first time, we believe, in a treatise on Protozoa, the Mastigophora are dealt with before the Rhizopoda.

The section on technique is a brief summary of methods of cultivating, investigating, and preserving Protozoa.

The special part of the work is a detailed description, in systematic order, of the structure and life-histories of the orders, families, and more important genera and species of Protozoa. Intercalated amongst the systematic descriptions are sections dealing with the parasitic and pathogenic importance of certain groups, namely, the Spirochætes, Flagellates, Amœbæ, and Telosporidia. In these sections the diseases produced by the Protozoa in question, and their pathology and etiology, are discussed, with figures and descriptions of the blood-sucking invertebrates which are responsible for their dissemination. From all this wealth of material we must be content to note a few points concerning debated questions. The theory of an alternation of sexual and non-sexual generations in trypanosomes, comparable to the alternating cycles of Hæmosporidia, is regarded as purely hypothetical and in need of proof. The author considers that it will probably be necessary in the future to place the genus Trypanosoma in the family Cercomonadidæ, in close proximity to Herpetomonas and Crithidia; on the other hand, Trypanoplasma is placed in a separate family, Bodonidæ. Schaudinn's statements with regard to the relationship of Trypanosoma to Hæmoproteus and Leucocytozoon are set forth in detail, together with the criticisms and objections of Novy, MacNeal, and others; judgment is suspended until more exact information shall have been obtained, but Hartmann's union of Hæmosporidia and Trypanosomes into one group, the Binucleata, is not accepted. The genus Hæmoproteus (Halteridium) is dealt with in an appendix to the Hæmosporidia, together with Babesia, Endotrypanum, and Leishmania; it will be a surprise to most protozoologists to meet with Leishmania in this company, and we are decidedly of opinion that its proper position is in the neighbourhood of Herpetomonas.

In the class Rhizopoda the forms with lobose pseudopodia and a shell are placed with the monothalamous Foraminifera, so that this order can no longer be defined by the reticulose nature of its pseudopodia. The Protomyxidea, including the genera Vampyrella, Pseudospora, Chlamydomyxa, and Labyrinthula, are placed as an appendix of uncertain position at the end of the Rhizopoda.

The Telosporidia are subdivided into Gregarinidæ and Coccidiomorpha; the second of these divisions includes the Coccidia and the Hæmosporidia, which are divided into Plasmodidæ and Hæmogregarinidæ. We regret to see the familiar generic name Coccidium replaced by Eimeria; this is one of those many cases where, in our opinion, rebellion against the law of priority in nomenclature is not only lawful but imperative.

The feeling aroused by even a cursory scrutiny of this book is one of dismay at the vast extent to which the subject has grown, astonishment at the erudition of the author, and gratitude to him for his painstaking diligence in putting together such a store of important facts and so useful a guide to the intricacies of the subject. It would not be difficult, perhaps, to point out parts of the book here and there in which certain subjects or groups have not been so well treated as others; the Hæmogregarines, for instance, are not dealt with very adequately. But a treatise of this size, on which the carping critic would be perforce silent, could hardly have been written by a human being, or even by several. It is seldom that so great a work is completed by one man at the present time. A striking feature of the book is the number of beautiful illustrations, and especially of previously unpublished figures, some by the author and some by other investigators; in particular we

would direct attention to many figures reproduced from those left behind by the late Dr. Fritz Schaudinn, which will be of the greatest interest to all protozoologists.

In conclusion, we have no hesitation in recommending this work to all those who wish to possess an admirable and exhaustive treatise on the Protozoa.

E. A. MINCHIN.

THE EARLY HISTORY OF NEW ZEALAND.

Murihiku, a History of the South Island of New Zealand and the Islands adjacent and lying to the South, from 1642 *to* 1835. By Robert McNab. Pp. xv+499; with plates and charts. (Wellington, N.Z.: Whitcombe and Tombs, Ltd., 1909.)

THOSE who are personally acquainted with that prosperous and very up-to-date portion of His Majesty's Empire now known as the Dominion of New Zealand will find it difficult to realise that so recently as the year 1835 the Customs House authorities in London decided that whale oil imported from that country was liable to a duty of 26*l*. 12*s*. per tun, on the ground that it did not come from a British possession. So many stirring events, however, had already taken place in New Zealand at this date that it has required eleven years of research to enable Mr. McNab to recover from the "forgotten past" the materials for a history of the southern portion of the Dominion from the time of its discovery by Tasman in 1642 up to the year mentioned. The task has been an arduous one, involving the close study of rare works in English, Spanish, French, and Russian, and the examination of countless official documents and files of local newspapers. Information has been brought together from every quarter of the globe, and not the least interesting of the author's discoveries is that of a series of manuscript logs of early voyages, which he found in the library of the Essex Institute at Salem, Massachusetts.

The classical explorations of Tasman, Cook, and Vancouver are already familiar to students of history, but the details of Bellingshausen's visit have hitherto been almost unknown to English readers. He commanded a Russian expedition which reached New Zealand in 1820. The narrative of the voyage, published in Russian, is now very rare. An abridged translation was published in German in 1904, and Mr. McNab has included in the present volume an English translation of the portions relating to New Zealand, the most interesting of which is a graphic account of the sea-elephant fishery which then flourished in Macquarie Island.

In the early part of the nineteenth century New Zealand and the adjacent islands were a kind of no-man's-land, and a happy hunting-ground for sealers and whalers from Australia and America. The records of these early trading expeditions, culled largely from the shipping reports and correspondence columns of the Sydney newspapers, contain much of thrilling adventure. The men must have been made of stern stuff who would consent to be left behind in small sealing gangs on an almost unknown coast, exposed to the attacks of the cannibal Maoris—attacks which were sometimes very successful—and with scanty supplies, while their ship continued her explorations, to call for them and their sealskins at some future date, often many months later. Sydney formed the headquarters of most of these expeditions. It was then a convict settlement, and we are told that Governor Phillip actually asked the English authorities for special powers to deport condemned men to New Zealand to be handed over as food for the natives!

The compilation of this work has evidently been a labour of love, but the author has none the less earned our gratitude by the manner in which he has fulfilled his task. Ethnologists and naturalists will both find a good deal to interest them in the book, but it is as a piece of historical research that it must be judged, and we expect that the writer of historical romance, as well as the more serious student of history, will profit largely by it in years to come.

A. D.

CHEMICAL CONTROL OF FOODSTUFFS.

Food Inspection and Analysis. For the use of Public Analysts, Health Officers, Sanitary Chemists, and Food Economists. By Albert E. Leach. Pp. xviii+954+xl plates. Second edition, revised and enlarged. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.) Price 31*s*. 6*d*. net.

THIS work, the first edition of which was reviewed in these columns some four years ago (NATURE, November 17, 1904, p. 57), is favourably known in this country as a very useful aid in the analysis of foodstuffs. For the information of readers interested in this subject and hitherto unacquainted with the volume, we may mention that it aims at giving, in a compass of about a thousand pages, a short description of the origin and composition of all the chief foods, condiments, and alcoholic beverages; together with a selection of the most approved methods for their chemical and physical examination.

General laboratory equipment is dealt with, and there are sections devoted to special apparatus, such as the microscope, camera, tintometer, refractometer, and polarimeter. Numerous tables of analytical constants are provided, as well as many illustrations of microscopical structure; in fact, the idea appears to be to make the book so far as possible self-sufficient for all ordinary work. The convenience of this is obvious; the essential information, enabling routine samples to be disposed of, is collected in one volume instead of being scattered over half-a-dozen. For assistance in dealing with special cases, where fuller details are necessary, a long list of references is appended to each chapter.

The new matter in the second edition runs to some 167 pages. A notable extension is made in the chapter devoted to cereals. Here we remark the inclusion of such matters as the use of pancreatin for starch-converting purposes alternatively to malt extract; a table (Kröber's) for determining pentoses and pentosans from the amount of phloroglucide; a scheme for complete ash-analysis, and sections dealing with the bleaching and examination of flour. These last, in addition to the usual methods for determining the proportions of gluten, gliadin, and other proximate

constituents of flour, include descriptions of baking-tests, absorption and dough-tests, and the two best-known means of recognising bleached flour, namely, extraction of the colouring matters with light petroleum, and the detection of nitrites in the sample.

An extension which will be found very useful is a separate chapter upon the examination of flavouring-extracts and their substitutes. Processes are given for the determination of vanillin, coumarin, benzaldehyde, lemon oil, wintergreen oil, and other essential oils occurring in extracts and essences; and notes upon adulterants and imitations are also included.

It will be readily understood that with so large a field to cover a single volume does not, even with a thousand pages, suffice for any exhaustive discussion of the various topics. The really difficult cases of adulteration, the doubtful "border-line" problems, remain always dependent for their solution upon the experience, skill, and wider knowledge possessed by the analyst. Beyond this general observation, however, there is little but praise to bestow upon the book. Apart from one or two misprints, the only questionable matter noticed is the Defren's table on pp. 595–7, where the values of lactose appear rather doubtful; and one may claim a little grumble at the pounds avoirdupois; the book is not, in the literal sense, likely to be a *vade mecum*. It will lie on the laboratory table, but it will be worth its place there. C. S.

THE MOVEMENTS OF CHROMATOPHORES IN PLANTS.

Die Gestalts- und Lageveränderung der Pflanzen-Chromatophoren. By Dr. Gustav Senn. Pp. xv +397. (Leipzig: W. Engelmann, 1908.) Price 20 marks.

CHROMATOPHORES in plants were for long regarded as merely temporarily differentiated fragments of the cytoplasm, and, even within the present decade, were viewed as cell-organs the physiological behaviour of which is largely or mainly determined by the general protoplasm; but more recent investigations have increasingly led botanists to regard chromatophores, not only as morphological individuals—so to speak—within the cell, but also as physiological organisms in the energid. The climax of this view is the suggestion that chromatophores are in phylogeny nothing more than descendants of parasitic green organisms which entered into symbiosis with cells not possessing chlorophyll. Though this extreme hypothesis is not favoured by Dr. Senn, the evidence which he supplies causes him to conclude that chromatophores have larger powers of active contractility and more varied irritability than has hitherto been believed. He concludes that their change of shape and movements in the cell are exclusively or mainly the result of their own special activity, and that they are not passively distorted or transported by the cytoplasm (though he naturally admits their passive carriage by rotating protoplasm and the like).

The book begins with the consideration of the change of shape of the individual chloroplast, a phenomenon generally neglected by botanical teachers, though easily visible in such familiar laboratory types as Funaria and Vaucheria. Dr. Senn describes the changes of shape in a number of types, and discusses the parts played in causing them by light, temperature, and chemical and other agencies. His general conclusion is that change of shape of the chromatophore is occasioned by "diffuse," not directive stimuli.

The main mass of the book deals, however, with changes in position of the chromatophores in the cell. Eight different patterns of distribution are recognised—epistrophe, apostrophe, systrophe (round the nucleus), peristrophe (uniformly round the cell-walls), antistrophe (on the wall facing the light), diastrophe (on the wall facing the light and on that opposed to it), parastrophe (in shaded parts of the cell), and escharostrophe (at the focus of the rays of light entering the cell). The conclusion is drawn that change of position of the chromatophores in the cell is the result of "tropic tactic [taxis] stimulus," in which the direction of the stimulus (for instance, light) does not as such determine the result, but only does so indirectly by involving a difference in intensity. According to Dr. Senn the distribution of the chromatophores in the cell is not the result of a simple stimulus emanating from the general protoplasm or released by differences in turgidity, but is the consequence of several types of irritability (phototaxis, chemotaxis, thermotaxis, osmotaxis) possessed by the chromatophores, which thus react in the same manner as free zoospores or Protozoa.

An appendix treats of the refractive index of the plant cell.

In a brief notice it is impossible to do justice to the wealth of detail in the book, which, except in the case of the special investigator, is one to be consulted rather than read through; indeed, the present reviewer confesses that he has not read the whole of the 376 pages of text.

Apart from containing the results of prolonged research and numerous observations, this critical book derives value from the thorough manner in which the author considers and does justice to the work of his predecessors, also from the repeated summaries of the conclusions arrived at concerning the various problems investigated, and from the rich bibliography and excellent index. The book, in fact, is one that should at least be in the library of every botanical institute.

MODERN ALGEBRA.

(1) *A New Algebra.* By S. Barnard and J. M. Child. Parts i.–iv., with answers. Pp. x+534. Price 4*s.* Part iv., with answers. Pp. x+(301–466). Price 1*s.* 9*d.* (London: Macmillan and Co., Ltd., 1909.)

(2) *College Algebra.* By Dr. S. C. Davisson. Pp. ix+191. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 7*s.* 6*d.*

(1) FEW branches of elementary mathematics have escaped the hand of the reformer during the last ten years. That this is a healthy symptom is unquestionable, for at least it points to a revival of interest, which cannot but infuse fresh life into a subject that the monotony of time may render arid and perfunctory. What measure of favour is to be

accorded to each set of changes must necessarily depend on the view that is taken of the purpose of a mathematical training in our educational system. It is not easy to form a combination of what is useful with what is interesting; and still less is it a simple matter to determine how far it is judicious to discuss at an early stage the fundamental ideas which underlie each branch of mathematics. But at the present time we believe that there is a dangerous tendency to pass over all considerations of mathematical philosophy as too difficult or uninteresting. We therefore welcome the present volume, which is a real attempt to build up an elementary course of algebra on the fundamental concepts of number and the operations to which it is subject.

The book is divided into four parts; the first deals with positive numbers, the second with zero and negative numbers, the third with irrationals, and the last with the more advanced applications, such as simultaneous quadratics, proportion, progressions, and the variation of simple functions. Each new idea that occurs is explained at considerable length in the text with admirable clearness, and is usually illustrated by graphical examples. In practice, no doubt, this will be used as the substance of an oral treatment, for few pupils will be sufficiently mature to be able to read and assimilate it unaided. There are abundant examples, a useful number of test papers, and an index which should prove of great practical value. We hope that this book will be widely used, for its principles are sound, and it introduces the student to a number of ideas that are both stimulating and instructive.

(2) This volume is intended to be used for a revision course. Stress is therefore laid on such features of the subject as are apt to be dealt with rather cursorily, or even omitted during the first reading. At the same time, however, the plan of the book is not designed to meet the wants of the professional mathematician, but to suit those who need a reasonably complete knowledge of the elementary principles of algebra. The remainder-theorem and the principle of undetermined coefficients are placed in an early chapter; the section on linear equations contains also the fundamental properties relating to the roots of equations of any degree; and the theory of simultaneous equations is expanded to include an elementary account of the use of determinants. By such means as these, the author has provided a course which is admirably adapted for a second reading. The treatment is fresh and vigorous, the explanations are clearly put, and great care has been taken to ensure that the student really understands the nature of the various operations which he is called upon to perform.

OUR BOOK SHELF.

Les Tremblements de Terre. By l'Abbé Moreux. Pp. vii+378. (Paris: Henri Jouve, 1909.) Price 4 francs.

On June 11, 1909, towns in south-eastern France, and particularly those in the district of Provence, were shattered by an earthquake. The places which suffered most were Salon, Lambesc, Saint-Cannat, Rognes, and Le Puy-Sainte-Réparade. Roughly speaking, the damage done to structures was estimated at 16,000,000 francs, which means something more than half a million sterling. From a monetary point of view this is a large sum, and it no doubt represents the effects of an unusually large earthquake. Had a similar rock adjustment taken place beneath a large city this sum would have been greatly magnified. The damage at San Francisco has been estimated at 70,000,000*l.* sterling. Naturally, the disaster excited the imagination, and survivors have speculated on the cause of earthquakes. One outcome of the thoughts which were so rudely created is the book by the Abbé Moreux.

The author has read much about earthquakes. At the outset, although he tells us that his writings are not addressed to specialists, he has taken pains to popularise speculations about which specialists have but slight knowledge. He gives us a series of pictures of the ruins, tells us about the heartrending cries of the people, the arrival of the doctors, the erection of huts, and the generosity of the Pope. Next we read about possible premonitory signs. We are told that before the earthquake people suffered from vertigo, clocks struck wrongly, whilst pigeons flew about rather than going to rest. One interesting picture, which is not unlike the Cullinan diamond, is that of our pyramidal earth, the fourth corner of which was found by Sir Ernest Shackleton.

Reference is made to recent investigations relating to seismology, from which we learn that our world has a rigidity double that of steel. Volcanic and seismic effects are not directly connected, but earthquakes are in part the result of tectonic adjustments. They hold a relationship to the wobbling of the pole, fluctuations in barometric pressure, the change of seasons, lunar and solar attractions, and to internal convection currents. Earthquakes explain certain perturbations of magnetic needles and earth currents, whilst they are closely associated with solar radiation. The periodicity of earthquakes and their prediction are subjects which are not overlooked, whilst many pages are devoted to construction in earthquake countries, and to the mitigation of disasters. The relationship of pressure to temperature as we descend in the earth, and the fact that bodies may during crystallisation, or when they pass from the fluid to the solid state, suddenly expand, are phenomena which the Abbé discusses at considerable length. In fact, we are told that the shock accompanying such expansions may be the principal cause of many earthquakes.

It is an interesting little book, and will furnish many with subjects for speculation which have never crossed their minds before. J. MILNE.

The Methods of Textile Chemistry, being the Syllabus of a Lecture Course adapted for use in Textile Laboratories. By Dr. F. Dannerth. Pp. viii+164. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1908.) Price 8*s.* 6*d.* net.

If the author had employed the title "Some Methods of Textile Chemistry" in place of the one he has chosen he would have erred on the right side. But to attempt to deal with the whole subject of textile chemistry—one of the most difficult and involved branches of analytical chemistry—in 120 small octavo pages of large type can scarcely result in anything of real value, even if the work is done as well as it is possible to do it. But when, as in the present case, the information is badly arranged, containing much that is superfluous if not useless, while omitting many matters of fundamental importance, and is not without a liberal sprinkling of mistakes and inaccuracies, the

inevitable result is a dismal failure. It is not quite clear for what class of reader the work is really intended, for in the preface we read that it "is intended to be a source of information and ready reference for the textile chemist," while on the title-page it would appear from the continuation of the main title, "being the syllabus of a lecture course adapted for use in textile laboratories," that it might be intended for some other purpose, possibly for teaching. In either case it has missed its mark.

These "knowledge in a nutshell" publications on technical chemistry, of which there appears to have been an increasing supply of late years, may be just the sort of thing that please people who like that sort of thing, but although there are a few exceptions, it is doubtful whether they do much good, while, on the other hand, they may do distinct harm through creating, under pretentious titles, a totally misleading impression of the subject as it presents itself in actual practice.

Naturwissenschaftliches Unterrichtswerk für höhere Mädchenschulen. By Prof. Dr. K. Smalian. Auf Grund der Bestimmungen vom 19 December, 1908, über die Neuordnung der höheren Mädchenschulwesens in Preuszen bearbeitet von K. Bernau. II Teil: Lehrstoff der VI Klasse. Pp. 80. Preis 1.80 marks. III Teil: Lehrstoff der V Klasse. Pp. 127. Preis 2.25 marks. (Leipzig: G. Freytag; Vienna: E. Tempsky, 1909–10.)

IN the early part of last year a notice appeared in NATURE of Dr. Smalian's "Leitfaden der Tierkunde für höhere Lehranstalten," a work comprising a zoological text-book in separate fasciculi intended for the use of the various classes in German high schools. The fasciculi now before us form part of another work designed on somewhat similar lines for the use of girls' schools, but including botany as well as zoology. The general commendation bestowed on the "Leitfaden" may be extended to the present text-book, with the addition that we have little fault to find with the coloured plates of animals, while those of plants are excellent examples of German colour-printing, and worthy of all praise. Each of the two fasciculi now before us is divided into a botanical and a zoological portion; and it may be presumed that the same holds good for the other portion of the series. The zoological section of the second fasciculus is devoted to vertebrates, and that of the third to arthropods. A number of well-known species of mammals are, however, described in the first fasciculus.

The general plan of the work is similar to that of the "Leitfaden," the various orders being treated in systematic order, and a certain number of typical species being selected for comparatively full notice, while other groups are treated more briefly. In the case of the species selected as types, leading features in the external form and structure and noticeable traits in the matter of habits are touched upon; and throughout the work technicalities are, so far as possible, avoided. The only scientific names introduced are those of species, ordinal and family groups being referred to by vernacular designations. In the main the species represented in the illustrations seem to be correctly named; but in one of the coloured plates the monkey designated *Cercopithecus sabaeus* is clearly *C. aethiops* or one of the allied forms, as it has the distinct white brow-band of the latter, which is absent in the former. So far as we can see, the book appears admirably suited for its purpose, although it by no means follows that it would be equally well adapted to the needs of English schools.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Meaning of "Ionisation"

IN asking for precision of language (p. 487), Prof. Armstrong shows how much he has fallen behind his time. If he had kept abreast of the recent developments of the principles of science, he would know that to be precise means running the risk of being wrong, which is to be avoided at all costs. Prof. Armstrong evidently belongs to an antiquated school which believed that scientific discoveries are made by forming definite ideas of things, even though these cannot be seen and handled. That is a standpoint which is abandoned, and we have entered on a new era. Science now aims purely at obtaining an equation which, without committing itself to any definite views, gives the required relationship between the brain impressions taking place in that particular dimension of a many-dimensional complex, which we identify with time. I am sorry if in this statement I have committed myself to the existence of a brain—it was lapse due to a weak concession to the prejudices of my youth, and would have been impossible in a thorough-going adherer to the new faith.

But to come to the point. If Prof. Armstrong will bring the theory of entropy to bear on the principle of least resistance to a cheap appearance of sagacity, he will discover, not what Arrhenius meant by ionisation—that is unimportant—but what he ought to have meant and would have meant if he were a chemical physicist such as we make them now. A. S.

The Fertilising Influence of Sunlight.

THE letter on the above subject by Mr. and Mrs. Howard in NATURE for February 17 raises a question of much scientific interest and of considerable importance in tropical agriculture. In some of the text-books it is stated that the hot sunshine of tropical or subtropical climates must injure the productiveness of the soil, since it kills bacteria. On the other hand, experiments on the partial sterilisation of soil by other means—such as heat or volatile antiseptics—shows that the killing of bacteria (as distinct from spores) leads to an increased, and not a diminished, productiveness. The apparent discrepancy is now cleared away, and we have Mr. and Mrs. Howard's authoritative statement that strong sunlight has beyond question a beneficial effect on productiveness.

There is a close resemblance between the effects they describe and those that have been obtained with partially sterilised soils by myself in conjunction with Dr. Darbishire and with Dr. Hutchinson; in all cases the effect is that of a dressing of nitrogenous manure. Dr. Hutchinson and I have traced this to an increased rate of decomposition of organic matter after partial sterilisation, and have shown that the increased activity is due to the destruction of some agent, probably large organisms, which had previously interfered with bacterial development. The question is, Could sunlight partially sterilise a soil and kill the large destructive and competing organisms that we suppose limit productiveness?

There are at least three factors involved: sunshine dries the soil, heats it to a certain temperature, and may have a direct chemical action fatal to the cell. We are at present studying the effect of dryness and of temperatures lower than 100° (at which we have previously worked), but the direct effect of sunshine is not easily investigated here. Some preliminary experiments I made at Wye during the summer of 1906 indicated that soil exposed to bright sunshine for a period of ten days subsequently absorbed oxygen more rapidly, *i.e.* showed a higher rate of bacterial activity, than another lot kept shielded from the light. The effect was comparable with that produced by volatile antiseptics, and, so far as the experiment goes, it shows that sunlight could, equally with these, remove the factor limiting productiveness in ordinary soils. I have several times attempted to extend the experiment, but

have been unfortunate in timing it, and have missed the continuous spells of strong sunshine.

We could not hope to attack the problem so successfully here as in India, and it would be interesting to have some Indian work on the subject. The experiments of Mr. and Mrs. Howard in conjunction with Mr. Leake on the "fertilising influence of sunlight" may be expected to throw a great deal of light on a very important problem.

E. J. RUSSELL.

Rothamsted Experiment Station, Harpenden.

The Spectrum of Bacterial Luminosity.

IN the course of some experiments on the phosphorescence of minerals, especially with regard to the emission of ultra-violet radiation, it was suggested to me by Prof. Strutt that it would be of interest to examine the spectrum of the light from luminous bacteria. Through the kindness of Sir James Dewar, Prof. Strutt was enabled to furnish me with a dish containing bacteria produced from fish which, when viewed in a darkened room, were seen to glow with a greenish-blue light bright enough to enable one to read a watch. The dish was placed in front of the slit of a quartz spectrograph of rather crude design, constructed with lenses of short focal length so as to utilise the light available to the fullest extent. A special rapid photographic plate was first exposed to the radiation from the bacteria for forty-six hours, and then to the light from a cadmium spark for one second.

The plate when developed exhibited strong evidence that the spectrum of the light emitted by the bacteria consisted of a continuous spectrum extending from wave-length 5000 (the lower limit of the sensitiveness of the plate) to wave-length 3500 tenth-metres, together with a well-marked bright band of wave-length 4000 approximately. Practically the same result has been obtained from bacteria produced from meat. The greater portion of the radiation is absorbed by a film of nitroso-dimethylaniline.

Mr. J. E. Barnard, in his article on luminous bacteria (NATURE, April 10, 1902), states that the light emitted by these organisms is confined to a small portion of the visible spectrum, and never extends into the ultra-violet or infra-red. The photographs I have obtained indicate that in some cases these bacteria emit ultra-violet radiation, and I hope with another spectroscope, now in course of construction, to obtain more definite information.

R. W. FORSYTH.

Royal College of Science, South Kensington, S.W., March 1.

Self-fertilisation and Loss of Vigour.

SOME of your readers will remember that in the introduction to "Cross and Self-fertilisation of Plants," Darwin inserts a report by Sir Francis Galton on seven tables of measurements relating to the relative heights of the offspring of cross and self-fertilised plants. "It is a very remarkable coincidence," says Galton, "that in the seven kinds of plants the ratio between the heights of the crossed and the self-fertilised ranges in five cases within very narrow limits. In *lea mays* it is 100 to 84, and in the others it ranges between 100 to 76 and 100 to 86."

If Table A of Darwin's book be referred to, it will be found that these ratios recur in many more than five cases. I write to suggest—with great diffidence, as I am a mere amateur in such matters—that the persistence of these ratios is capable of simple explanation on the basis of the Mendelian theory of heredity.

The distribution or "array" of a Mendelian family, crossed at random, is given by the expansion of $(3D+R)^n$, where n = the number of pairs of characters involved, and the powers of D and R respectively represent the number of dominant and recessive somatic characters of each individual. If, now, each individual be self-fertilised, the array can be shown by simple algebra to become $(5D+3R)^n$. Similarly, in the next self-fertilised generation, the array becomes $(9D+7R)^n$, and so on. The average number of dominant characters in each generation is, consequently, $\frac{3}{4}n$; $\frac{5}{8}n$; $\frac{9}{16}n$, &c., which give the ratios 100 : 83 : 75, &c.

It is surely something more than a "remarkable coincidence" that these ratios agree in so many cases with the ratios observed by Darwin?

A. B. BRUCE.

School of Agriculture, Cambridge, February 19.

Vision and Colour Vision.

WITH reference to the comment on my lecture at the Royal Society of Arts in NATURE of February 17, I did not give the evidence in favour of the visual purple being the visual stimulus transformer on account of the time at my disposal. This evidence is very strong, and the facts are inexplicable on any other hypothesis. Many physiologists have tried to assign different functions to the rods and cones, but these theories have failed because all the functions which were said to be the exclusive property of the rods have been found, only gradually diminished, in the fovea, in which only cones are present. For instance, von Tschermak, Hering, Hess, Garten, and others, have found the Purkinje phenomenon, the variation in optical white equations by a state of light and dark adaptation, the colourless interval for spectral lights of increasing intensity, the varying phases of the after-image, in the fovea, only gradually diminished. The complete absence of any qualitative change between the foveal and extra-foveal regions is a very important fact in support of the hypothesis that the visual purple is the visual substance. There is also the fact, mentioned by Helmholtz, that a perceptible interval elapses before we see with the fovea, after the rest of the retina, when the eye has been previously some time in darkness. Hess has also pointed out that the recurrent image is present, but retarded at the yellow spot. All these observations and many others agree with my statement that the visual purple can be seen between but not in the cones of the fovea.

F. W. EDRIDGE-GREEN.

Hendon, February 19.

The Methods of Bird Fanciers.

MAY I ask for information on the following matter?

Happening to be walking in a poor quarter of Acton (Chiswick) with a friend, we were astonished to see hanging outside a house, on either side of the door, two small bird-cages completely enveloped with dark cloths carefully fastened. The cages evidently contained birds, for from one of them came the song of a chaffinch.

Had the birds suffered the torture of having their eyes put out to make them sing, or is this a method resorted to instead of blinding them?

The caging of wild birds is so very cruel that it should be exposed in all its barbarous ways.

Some of the wild birds are kept in such small cages that there is scarcely room for them to turn round.

E. L.

IT is customary for bird fanciers amongst the lower classes to match one chaffinch against another, often in public-houses, the bird which sings the largest number of notes being adjudged the victor. When the cages are carried about they are usually wrapped up in dark cloths, and it is said that one of the objects of keeping the birds in the dark is that they should imagine it is night while they are covered, and that on the cloth being removed, thinking it is day, they burst forth into song. As it is believed by some that birds sing better when they are blinded, it may be, as "E. L." suggests, that the covers were used in the case mentioned either to avoid practising the cruelty of putting out the birds' eyes or so that the fancier might not render himself liable to the punishment for doing so. More likely the birds that were kept covered were newly caught, and the object was to prevent them from dashing themselves against the bars of the cages in their endeavours to escape. As has often been pointed out, one reason for the smallness of the cages used is to lessen the danger of the birds killing themselves, as in a larger space they could begin to fly and would strike with greater force.

WILFRED MARK WEBB.

Title of the Natural History Museum.

IN NATURE of February 24 (p. 489) Mr. Hobson suggests as both "suitable and adequate" that it should be called the "British Museum of Natural History."

Why not omit "British" and "of," re-arrange the order of the words, and call it "The Natural History Museum," adding "London" if necessary?

Torquay.

F. HOWARD COLLINS.

NORTH POLAR OCEANOGRAPHY.[1]

A HANDSOME volume full of useful information has been given to oceanographical science by H.R.H. the Duke of Orleans, the result of a cruise in the Greenland Sea during the year 1905. This is one of a series of Arctic cruises His Highness has been making for a number of years, the last having been during the summer of 1909. On each of these voyages the Duke of Orleans has carried with him an excellent scientific staff on board his yacht, the *Belgica*, a vessel already known in Antarctic exploration. Among those who have been with him are Dr. Récamier, who has accompanied the Duke on each of his previous voyages, as well as Captain Adrien de Gerlache, formely leader of the Belgian Antarctic expedition, M. E. Mérite, the artist-naturalist, and Mr. E. Koefoed.

The volume opens with a narrative of the voyage and an extract of the ship's journal, by Captain de Gerlache. The *Belgica* left Tromsö on June 3, and, passing northward to the west of Spitsbergen, sighted Prince Charles Foreland in exceptionally clear weather, reaching 80° 20′ N. in this longitude. From this point the Duke attempted to push westward towards Greenland, not to establish "un vain record," but to carry on serious scientific investigations in an unexplored region of the Arctic Ocean. This attempt was repulsed by heavy ice, which drives southward from the polar basin between Spitsbergen and Greenland. The special object was to verify the hypothesis that a ridge separated the Greenland Sea from the North Polar basin, but though unsuccessful in this attempt, the expedition succeeded in crossing from east to west over to the Greenland coast in as high a latitude as 75° 30′ N., a region which has been inaccessible to other expeditions trying it. Along this route a complete set of soundings and serial temperature and salinity observations were made. The coast of Greenland was met on July 27, and the Duke landed on an island, rich with Arctic vegetation, just south of Cape Bismarck, and which he named "Ile Maroussia." At 8 a.m. on July 28 the *Belgica* was four miles north of Koldewey and Payer's cairn, the furthest north point of the German expedition of 1870. At noon the *Belgica's* position was 77° 20′ N., 18° 20′ E., and in the evening a party landed on a previously unknown island, which was named Ile de France, the south-east cape of which, in 78° 38′ N., 17° 36′ W., was named Cape Philippe. Here the French colours were hoisted. Koefoed found nineteen phanerogams, seven mosses, four fungi, and six lichens; hares, ptarmigan, foxes, and lemmings abounded. The remains of Eskimo encampments were also found.

FIG. 1.—The *Belgica* in land ice on August 4, 1905 (Lat. 77° 29′ N., Long. 18° 31′ W.).

At midnight on July 30 the *Belgica* was in 78° 16′ N., 16° 48′ W., or 167 miles further north than the *Germania* in 1869. From this point the *Belgica* pushed eastward, and thirty miles eastward, after getting shallowing soundings of 245, 120, and 55 fathoms, struck bottom at 32 fathoms, and named this bank the Belgica Bank. Six miles to the south-east of this point the water deepened again to 109 fathoms. de Gerlache suggests that there may be an island in the vicinity, noting that two crows and a walrus were seen. After this the Duke returned by more or less the same route so far as Cape Bismarck, and from there in a more or less southerly direction in, and along, the edge of the Greenland pack, which they lost sight of on August 21 in about 67° 30′ N., 24° E. It is satisfactory to note that at almost the furthest north point reached a well determined position

[1] Duc d'Orléans. "Croisière Oceanographique accomplie a bord de la *Belgica* dans la Mer du Grönland, 1905." Pp. v+568; lxxix plates. (Brussels: Bulens, 1907.) Price 100 francs.

was obtained, viz. 78° 13′ N., 16° 30′ W., and that the coast was mapped approximately to 79° N. All that is mapped is satisfactorily determined except Cape Bourbon and Cape Bergendal, the distances of which were judged, only single angles being taken. A good declination was obtained in 77° 35′ N., the result being 37° N.W.

Full extracts of the journal compiled on board are published. Here we are given the time and position, the weather, the sea, ice observations, stations, and movements of the ship, and the animals met with, in a thoroughly systematic manner. Next come a list of eighty soundings and fifty oceanographical stations, showing good solid work. The soundings vary from 12 to 1846 fathoms. Many hydrographic observations were taken, and plankton and other fishing was carried on.

Meteorology has been well handled by Dr. Dan la Cour, the observations of twenty-two ships having been considered, as well as thirty-eight land stations, though one misses the observations taken by Scottish whalers in the Greenland Sea and Davis Straits. There are ninety-six synoptic charts for July and August, 1905, which are of great interest.

Mr. O. B. Boggild reports on the geology. He has a theory of a submarine moraine existing to the east of Greenland, running parallel with the coast, but this is scarcely supported by the bathymetrical chart (plate lvi.). The geological observations at Cape Saint Jacques (77° 36′ N.), on the Ile de France, are of most interest. Here there are gneisses and schists, and possibly some Devonian rocks probably identical with those that Nathorst found further south. Plate lx. shows deposits from the north of Scotland to north of 80° N. All is blue mud, except the globigerina ooze, which pushes north-east from west of Scotland to within 240 miles of Bear Island, broken only by the volcanic muds of Iceland and the Færöes.

Dr. C. H. Ostenfeld treats the botany in a systematic manner, but beyond the further northern extension of known East Greenland species there is naturally nothing very novel.

Mr. Einar Koefoed and Captain de Gerlache give an account of oceanographical equipment which, with the exception of the excellent Lucas sounding machine, was mostly Danish or Norwegian. There follows a useful journal of the fifty stations, mostly in the Greenland and Spitsbergen seas. This journal gives a summary of the hydrographic and other work done at each station, and lists of planktonic species. Messrs. B. Helland-Hansen and E. Koefoed then proceed to discuss the hydrography of the expedition, and no expense is spared in enhancing this part of the report with a very excellent series of useful, interesting, and beautiful plates and maps for the purpose of demonstrating the distribution of depths, temperature, salinity, currents, &c. Most of the introduction is a summary of the hydrographic work of previous expeditions to the Greenland seas, but Messrs. Koefoed and Helland-Hansen have made no mention of Mr. Leigh Smith's work of 1870, nor of that done on board the *Princesse Alice* during 1898 and 1899, mostly by Mr. J. Y. Buchanan and the reviewer. Leigh Smith was the first to notice the intermediate warm layer in these seas which is specially dealt with by

FIG. 2.—Cape Philippe.

FIG. 3.—Duke of Orleans Land, near Cape Amelia

Messrs. Koefoed and Helland-Hansen, yet no mention of this veteran's name or work is made. Buchanan, Nansen, Bruce, and others have also observed this phenomenon. We doubt also if some of these old observations are less exact than those of more recent date. The Buchanan methods give, for instance, observations of great exactitude, and certainly equal to any of the most recent observations of the younger Scandinavian school of oceanographers.

Part ii. deals with instruments and methods; and here useful discussion could be entered upon, as, for instance, on the question as to whether one is able to obtain results of greater accuracy with the more finely graduated Richter thermometer on the deck of a ship in the polar regions, with discomforts of mist, sleet, snow, wind, and weather. A stronger marking and coarser scale certainly in many cases will give more accurate results than the very finely-graduated scale of the Richter thermometer instruments, as the reviewer knows by extensive work on board ship in all weathers and almost all latitudes. The question of a ridge rising to within about 400 fathoms of the surface is discussed, but so far no absolute proof of this has been obtained, owing to the great difficulty of penetrating the polar pack—some of the heaviest ice in the world—between the north of Spitsbergen and the east of Greenland. The Duke of Orleans has, however, come nearer accomplishing this important investigation than anyone else, for he obtained a more complete line of soundings two degrees further north in the middle longitudes of the Greenland Sea than any previous navigator.

The authors divide the Greenland Sea into three areas:—

(1) East—having high temperatures and salinities, being influenced by the Gulf Stream.

(2) Middle—a deeper region with mixed conditions.

(3) West—a shallower region with low temperatures and salinities, being influenced by the polar current.

Plate lxii. gives a chart indicating the stations of the *Belgica* and those of other expeditions in the Greenland seas and regions adjacent; but again we miss the stations of Leigh Smith, 1870, those of Bruce (S.Y. *Blencathra* of Major Andrew Coats), 1898, and those of the Prince of Monaco, 1898–9. Many interesting problems are raised by the temperature, salinity, and current observations made by the Duke of Orleans and his staff, and not least of them is the theory of the Spitsbergen-Greenland ridge already referred to, but it is impossible in this short review to enter fully into all these questions.

The zoology of the voyage, discussed by Prof. C. Hartlaub, Messrs. D. Damas, E. Koefoed, and M. J. G. Grieg, occupies more than a third of the volume. The plankton work is very exhaustively and thoroughly handled by Messrs. Damas and Koefoed. Several dredgings in depths down to 750 fathoms also secured a number of interesting benthoic forms. The numerous inset maps and sectional diagrams and tables are especially useful, bearing as they do on the distribution of plankton.

The plates by Werner and Winter maintain the high reputation this firm has justly won. M. Édouard Mérite's work is reflected throughout the natural history of the expedition, though much of this excellent artist's colour work only appears in the Duke of Orleans's less technical work, "A Travers la Banquise du Spitsberg au Cap Philippe." Dr. Récamier, too, did much to make the voyage a success. There are useful sketches of the new coast between 77° and 79° N., and some most excellent half-tone blocks, many of which show polar ice well; the frontispiece is especially to be commended as "a thing of beauty." One regrets to see that glazed paper is used instead of pure rag paper, which actually produces richer effects and is infinitely more durable.

Altogether the Duke of Orleans is to be most heartily congratulated, not only for having personally conducted all the above work, but even more so for having placed the observations and material gathered during the voyage into competent hands for examination and description, and for having spared no trouble or expense in bringing out a volume which is second to none as a monumental contribution to the oceanography of the Arctic Ocean. Too often polar expeditions are dispatched by the help of men of means, but these same people have little or no conception of making use to the full extent of the material, obtained with great care, toil, and trouble, on the return of the expedition. The excellent work of many trained men of science who accompany such expeditions is in consequence largely wasted. The Duke of Orleans, however, has realised the full value of this subsequent work, and the thanks of the scientific world is due to him for having seen it through so handsomely to the finish.

William S. Bruce.

AËROPLANE STABILITY.

In 1896 I had the pleasure of attending a lecture on naval architecture given before the British Association in Liverpool by the late Dr. Francis Elgar, F.R.S. I had learnt the theory of the metacentre in my undergraduate days, but it came to me as a great surprise to learn that this theory had only been evolved after many ships had foundered, owing to want of theoretical knowledge of their conditions of stability.

I was interested in aërial navigation at the time, and although I had not got further than throwing gliders, it was evident from their behaviour that a mathematical theory of stability must necessarily be of even greater importance in connection with aërial navigation than with naval architecture, and I wrote in *Science Progress* to the effect that if the future development of artificial flight were not to be a repetition of the chapter of accidents by which naval architects had gained their theoretical knowledge, there would be abundant work for mathematicians in reducing the conditions of stability to pure calculation.

About the year 1903 I noticed that if a glider or other body is moving in a resisting medium, such as air, in a vertical plane with respect to which it is symmetrical, the small oscillations about steady motion in that plane are determined by a biquadratic equation; and Prof. Love directed my attention to the condition of stability given by Routh. Mr. W. E. Williams was a post-graduate student in my department, and with his collaboration we published a paper on "The Longitudinal Stability of Aërial Gliders" (Proc. Royal Soc., lxxiii.), which was intended to direct attention to the general method, and the importance of further investigation, rather than to furnish a complete solution of the problem.

Mr. Williams shortly afterwards obtained a so-called "Research Fellowship"; but "research" in this case was interpreted as meaning practical work done in a physical laboratory away from Bangor, so the award had the effect of preventing the continuation of original work on this important problem. On the other hand, the necessity of providing, with one assistant, classes in all grades of pure and applied mathematics, and of devoting special attention to the requirements of junior students whose knowledge of the "first four books" and of arithmetic had been neglected at school, left no time for me to carry on the work single-handed. It is only since the comparatively recent abolition of these *infra* university

courses that I have been able to give any attention to the subject.

Some criticisms having been raised by the late Captain Ferber, mainly referring to the form in which the conditions of stability were stated, I suggested his developing the work as I had not time to do so. His results were published in the *Revue d'Artillerie*, October and November, 1905, and include a discussion of lateral as well as of longitudinal stability.

At the beginning of last year the work of my department was, for some unknown reason, exceptionally light, and I had in Mr. E. H. Harper an assistant well able and willing to collaborate in a much more exhaustive investigation both of longitudinal and lateral stability. About October I received a formal letter of inquiry from the Government Committee, in an envelope which I at first took for an income-tax application, and in reply stated that what I wanted was a small grant to enable me to devote my whole time to this work. I received a reply that the committee "regretted," &c., but that "very great interest was taken" in the work. The main difficulties of the subject have, however, now been practically cleared up, though a long time must elapse before a detailed written account is ready for publication. Had any prizes been offered in England for which such an investigation would be eligible, the delay might have been avoided or shortened.

Reference must be made also to Mr. Lanchester's remarkable investigations, published in his "Aërodonetics," and to the appearance of a German translation of the preceding volume, "Aërodynamics," shortly after its publication in English.

It is here proposed to give a general idea of the peculiarities of aëroplane stability as deduced from my work, and a comparison with Ferber's and Lanchester's methods; though with regard to the latter it is rather difficult for any critic to be sure of not misjudging the author's intended meaning.

It is necessary that the distinction between equilibrium and stability should be kept in mind. An aëroplane is in *equilibrium* when travelling at a uniform rate in a straight line, or, again, when being steered round a horizontal arc of a circle. A badly balanced aëroplane would not be able to travel in a straight line. The mathematics of aëroplane equilibrium is probably very imperfectly understood by many persons interested in aviation, but it is comparatively simple, while the theory of stability is of necessity much more difficult.

It is necessary for stability that if the aëroplane is not in equilibrium and moving uniformly it shall tend towards a condition of equilibrium. At the same time, it may commence to *oscillate*, describing an undulating path, and if the oscillations increase in amplitude the motion will be unstable. It is necessary for stability that an oscillatory motion shall have a positive modulus of decay or coefficient of subsidence, and the calculation of this is an important feature of the investigation. A slight reference to this question of rolling is given by Chatley on p. 99 of "The Problem of Flight," but he seems to have overlooked the fact that this damping may be, and often is, negative in the case of unstable aëroplanes.

At the present time it is certain that aviators rely on their own exertions for controlling machines that are unstable, or at least deficient in stability, and they even allege that, owing to the danger of sudden gusts of wind, automatic stability is of little importance. Moreover, even in the early experiments of Pilcher, it was found that a glider with too V-shaped wings, or with the centre of gravity too low down, is apt to pitch dangerously in the same way that increasing the metacentric height of a ship while increasing its "statical" stability causes it to pitch dangerously. It thus becomes important to consider what is the effect of a sudden change of wind velocity on an aërodrome. If the aërodrome was previously in equilibrium it will cease to be so, but will tend to assume a motion which will bring it into the new state of equilibrium consistent with the altered circumstances, *provided that this new motion is stable.* Thus an aërodrome of which every steady motion is stable within given limitations will constantly tend to right itself if those limitations are not exceeded. Excessive pitching or rolling results from a short period of oscillation combined with a modulus of decay which is either negative (giving instability) or of insufficient magnitude to produce the necessary damping.

The new work depends very largely on the property that for a system of *narrow aëroplanes inclined at small angles to the line of flight* approximate methods may be used, greatly simplifying the algebra, and enabling the various oscillations to be separated and their moduli of decay to be calculated approximately. Of the six equations of motion as applied to the small oscillations of a symmetrical aërodrome, three determine oscillations in the plane of symmetry, and lead to conditions of *symmetric* or *longitudinal* stability. The other three determine asymmetric or skew symmetric oscillations, leading to conditions of *asymmetric* stability. The three equations in each set are mutually interdependent, but independent of the other three, thus accounting for the fact that Lanchester found it impossible to separate "lateral" and "directional" stability. Failing any better terminology, I have provisionally adopted the term "asymmetric" stability.

Of the two, symmetric stability presents by far the simpler problem. For the systems above mentioned there are two symmetric oscillations, one of long and one of short period. The short-period oscillation consists mainly of an oscillatory motion of the centre of gravity perpendicular to the line of flight (*i.e.* a vertical oscillation if the aërodrome is moving horizontally), combined with a rotatory oscillation about the centre of gravity. To a first approximation it produces no fluctuations in the velocity in the line of flight, and is unaffected by head resistance or fluctuations in the propeller thrust, provided the latter passes through the centre of gravity of the aërodrome, as has been assumed in many of our calculations. The condition of stability depends only on the areas and positions of the aëroplanes relative to the centre of gravity, and is independent of the inclinations or angles of attack of the planes, the oscillations remaining finite when the planes are parallel. This condition of stability is generally satisfied in any arrangement which satisfies the other conditions of stability. It must not be overlooked, though it is very unlikely to give trouble. The corresponding *trajectory* or *curve of oscillation* is independent of the velocity, the actual *time rates* of oscillation and decay being proportional to the velocity.

In the slow oscillations the variations of velocity in the line of flight are a predominating feature. The trajectory is wave-like, the crests of the waves being more pointed than the troughs, and the descending parts steeper than the ascending ones. This is evidently the type of oscillation studied by Mr. Lanchester. One condition of stability is that the front plane (or planes) must be inclined at a greater angle than the rear ones. The second condition depends on the type of machine.

The terms "monoplane" and "biplane," as usually defined, refer to the question of whether a machine has not or has superposed planes. According, how-

ever, to a property which I call the *principle of independence of height*, this distinction does not affect stability to any appreciable extent. The important point is whether the weight is sustained partly by the front and partly by the rear planes, as in certain Voisin machines, or is wholly supported by the front planes, the rear ones acting merely as a tail in the neutral position. For a monoplane with neutral tail the condition of stability takes the form given by Lanchester, when the necessary substitutions have been made by making use of the condition of equilibrium. The reason why Lanchester's method leads to a correct result is to be sought in considerations of the peculiar nature of the oscillations, and in especial in the relative smallness of their modulus of decay. For a machine of the Voisin type, with sustaining surfaces arranged tandem, the condition of stability is nearly as simple, and certain modifications are sufficient to cover the case when the propeller thrust does not pass through the centre of gravity provided that this thrust is constant.

A very convenient plan in such cases is to suppose the actual machine replaced by an *equivalent monoplane*, with neutral tail, although if the inclinations of the planes be varied for vertical steering the equivalent monoplane will be changed.

The most remarkable result, however—and Mr. Harper was the first to point this out to me—is the *important effect on stability of the direction of motion in the vertical plane*. Longitudinal stability falls off rapidly when the aëroplane begins to rise, even if other things are constant. A monoplane would, under theoretical conditions, become unstable when ascending at an angle to the horizon of *less* than twice the angle of attack (or inclination of the main plane to the line of flight).

The effect of head resistance is to increase the stability, and a further increase occurs if the thrust of the propeller, instead of being constant, decreases when the velocity increases. By the use of three planes instead of two, an additional increase of stability can be obtained. On the other hand, if the aëroplane be gliding downwards the longitudinal stability is greater than in horizontal flight.

I think the above conclusions indicate a source of danger which may possibly have led to mishaps when aëroplanes have risen too rapidly in the air.

Captain Ferber's investigations, on the other hand, refer mainly to the stability of a single aëroplane as dependent on fluctuations in the position of the centre of pressure consequent on variations of the angle of attack. He assumes Joessels's formula, introducing two arbitrary constants in place of the numerical coefficients. The difficulty I have several times pointed out is that, if a plane is turning over, its rotational motion may affect the position of the centre of pressure, as well as possibly the resultant thrust, and no experimental information is apparently available on this point. For this reason the use of narrow aëroplanes is to be recommended, stability being secured by a tail or by two planes placed one behind the other. Moreover, the theory of narrow aëroplanes gliding at small angles affords the simplest introduction to a general study of aëroplane stability, just as geometrical optics in which aberration is neglected affords an introduction to a general study of lens construction. It is to be remembered that both the symmetrical and asymmetrical oscillations are determined by equations of the fourth degree, each in the form of a determinant of the third order containing the dynamical constants and resistance coefficients, and when this determinant has been expanded, *four* conditions of stability have to be satisfied, one being that Routh's discriminant $BCD-AD^2-EB^2$ shall be positive. Fortunately, for purposes of approximation, $CD-EB$ may be substituted for the last in many of the systems occurring in aviation. It will thus be seen that stability is a very complicated problem, and that approximate methods are essential.

Asymmetric stability is far more difficult of investigation than symmetric. It is necessary to take account of the separate effects of straight or horizontal aëroplanes, vertical fins, and bent-up or V-shaped planes. The late Captain Ferber's solution is based on the substitution for the actual planes of their projections on three coordinate planes (p. 46 of his paper). Unfortunately, even assuming the sine law of resistance, this substitution does not seem to give even the correct first approximation which is all the author claims. In particular, if the aërodrome is rotated about any axis in its plane of symmetry, couples are set up on the main aëroplane which have an important effect on the stability, but are apparently not included in his scheme. The final result is a biquadratic with one root equal to zero, and Captain Ferber regards an aëroplane as stable when it describes a helix; whereas such an arrangement should really be regarded as lacking in stability. The couples in question are taken account of by Lanchester, who uses what he calls "aërodynamic and aërodromic radii" to represent their effects. For a narrow aëroplane gliding at a small angle, the effect depends on the moment of inertia of the area of the plane about the vertical plane of symmetry. A horizontal tail of negligible lateral dimensions does not affect the asymmetric stability.

To secure stability, recourse must be had to vertical fins, or to bent-up aëroplanes or aërofoils. The effect of vertical fins (neglecting "wash") depends on their areas, and the first and second moments of these about the axes, and in studying them it is necessary to have recourse to the "principle of parallel axes." The sections in "Lanchester" on "fin resolution" practically embody this principle, but are a little difficult to follow; they suggest the path taken by an explorer who had not a compass to guide him to the mathematically direct road in the form of the principle in question. His conditions of stability seem reasonable deductions from the hypotheses he makes, but the conclusions must not be regarded as final. Both the necessary and the sufficient conditions of stability are really far more complicated, and it is highly improbable that the problem could have been carried much further without the elaborate use of analysis which I have found necessary, and the assistance of an independent calculator, which Mr. Harper has kindly provided. The only way of proceeding was to calculate the coefficients in the biquadratic for particular arrangements of fins and planes, starting with the simpler ones, and passing to more complicated ones *when one has become thoroughly familiar with the different terms and their meanings.*

For an aëroplane with one vertical fin only, the conditions of asymmetric stability require that the centre of pressure of the fin should be slightly in front of the centre of gravity of the machine, while at the same time it should be at a height above the centre of gravity large compared with its distance in front. Two of the conditions of stability are difficult to reconcile with the conditions of equilibrium, the difficulty increasing as the velocity increases and the angle of attack diminishes; moreover, they are inconsistent unless a certain relation holds between the radii of gyration of the machine and of the main supporting surface. It is doubtful whether this condition would be consistent with practical requirements.

The failure of practical aviators to obtain automatic stability may be due in no small measure to the number of conditions that have to be satisfied. A vertical fin in front might satisfy one condition of stability, and introduce instability through another condition, while a similar fin at the back might satisfy the second condition and introduce instability through the first. In either case the impression produced would be that the device secured automatic stability, but that such stability was a hindrance rather than a help, the correct interpretation being that the conditions of stability had not been sufficiently investigated. By abolishing the fins the aviator would obtain a machine with *defective stability, i.e.* with one or more roots of the biquadratic vanishing, and would find it easier to maintain his balance by artificial control than in the previous unstable arrangement.

Of arrangements with two fins, the cases have been considered where both fins are at the level of the centre of gravity, where one is above, and where both are above. The conditions of stability assume various forms, but there is one arrangement which appears to possess an exceptionally wide range of stability, and I have made provisional application for a patent in this connection.

A machine such as the Voisin type, with two planes of considerable span at different angles of attack, is more stable than one with a single sustaining system, and the difference is equivalent to a variation in the arrangement of the fins which is easily calculated.

The asymmetric oscillations of an aërodrome do not separate into two kinds, of long and short period, like the symmetric ones. As a general rule the biquadratic has one root determined approximately by the first two terms representing a quick subsidence, one root determined by the last two representing a slow subsidence, and a pair of roots determined by the middle terms representing a damped oscillation.

The inclination of the flight-path to the horizon has a considerable influence on the asymmetric stability. In several instances we found that instability occurs when an aërodrome is descending at an angle to the horizon the tangent of which is double that of the angle of attack of the main planes. Other arrangements become unstable when rising at more than a certain angle; in the best arrangement referred to above the stability is practically independent of the inclination. As the symmetric and asymmetric oscillations of an aëroplane are independent, it is important that it should preserve its asymmetric stability even when it is not in longitudinal equilibrium. The dependence of stability on inclination affords a very simple and likely explanation of certain "vagaries" described on pp. 342, 343 of Lanchester's "Aërodonetics"; account would, however, have to be taken of accelerations of the centre of mass in an exact comparison of theory with observation.

Bent-up or V-shaped wings lead to much more difficult analysis, and it appears that their effect is not exactly equivalent to any combination of vertical fins except in certain cases. A pair of "stabilisers" or small planes, which may be fixed at the extremities of the main aëroplanes at an angle of, say 45°, is equivalent to a single raised vertical fin if the planes of the stabilisers are parallel to the line of flight.

Mr. Harper has worked out the asymmetric stability of the Antoinette type with a single pair of bent-up supporting surfaces. The conditions of stability are satisfiable by furnishing the machine with a tail of suitable length, or by raising the dihedral angle of the V-shaped wings above the centre of gravity.

I should like to direct attention to the importance of eliminating the personal element in experimental tests of aëroplane stability, by the use of models. The possibility of long-distance flights by skilled aviators having been demonstrated, there is not so much point in repeating these verifications as in extending our knowledge in other directions, and finding how far the element of skill can be dispensed with by effecting improvements in aëroplane design.

The stability of dirigibles opens up another field of study, on which we hope to do something during the coming year.

Owing to the attention now given to aëroplane construction, it appeared desirable to give, in the present article, an advance account of investigations which may not be ready for publication *in extenso* for some time to come.

G. H. BRYAN.

Added January 27, 1910.—The *Aëronautical Journal* for January, now to hand, includes a short abstract, illustrated by badly executed diagrams, and containing numerous uncorrected printers' errors, in which the symmetric stability of a single-surfaced aërodrome without tail is made to depend on a cubic instead of a biquadratic equation. This result is obtained by the very doubtful method of "assuming V to be constant for a short period," that is, neglecting fluctuations in horizontal velocity. Owing to this assumption the conclusions reached may perhaps represent the conditions that the machine may be stable with reference to the shorter oscillations, but not with respect to the longer ones, and the inference that a machine can be much more stable at moderate velocities than is generally supposed must not be regarded as conclusive.

THE WORK OF THE WOBURN FRUIT FARM.[1]

AMONG the profusion of agricultural and horticultural reports, many of which can at best be said only to possess a very ephemeral interest, it is pleasant to come across something of permanent and abiding value, work carefully executed and followed to its logical conclusion.

Such must be the feeling of every discerning reader as he studies the report by the Duke of Bedford and Mr. Spencer Pickering on the chemical relationships of the copper fungicides. The problem is one of very great economic importance. Modern conditions of fruit-growing tend to foster and distribute from country to country the fungi parasitic on fruit trees. On the other hand, the grower is more and more anxious to keep them down; not only do they adversely affect his yield, but they often spoil the looks of his fruit, a very serious matter in modern markets.

The most popular fungicides are the copper compounds, more particularly Bordeaux mixture, a basic salt prepared by adding lime to a solution of copper sulphate. This mixture has been used by fruit and potato growers for a number of years with great success, and has formed the subject of a vast number of papers. Unfortunately few of them are of much value, since it only rarely happens that a man is found to combine an interest in horticultural problems with exact habits of thought. Until recently nothing was known of the composition of Bordeaux mixture, not even the proportions in which the constituents should be mixed to give the best results. Certain American investigators recommended 4 lb. of copper sulphate in fifty gallons of water, and some of the English writers, borrowing not too intelligently in this as in other matters, recommended the same strength, oblivious of the fact that the American gallon is little more than four-fifths of the English

[1] Eleventh Report of the Woburn Experimental Fruit Farm, by the Duke of Bedford, K.G., F.R.S., and Spencer U. Pickering, F.R.S. (The Amalgamated Press, Ltd., 1910.)

gallon. There are several other recipes, but nothing enabling one to decide which is the best. The mode of action is even more obscure; indeed, the whole subject was in a state of confusion until Mr. Pickering took it in hand and began to evolve something like order.

The reaction between copper sulphate and lime is shown to yield four basic sulphates:—(*a*) $4CuO,SO_3$; (*b*) $5CuO,SO_3$; (*c*) $10CuO,SO_3$; (*d*) $10CuO,SO_3,CaO$; and two other compounds (*e*) $CuO,2CaO$ (existence doubtful); (*f*) $CuO,3CaO$. The conditions of the formation of each of these basic sulphates were investigated and a series of the corresponding Bordeaux mixtures prepared.

The properties of the sulphates were studied, and in particular their decomposition under the influence of water and carbonic acid in presence of calcium sulphate or of organic matter, these being the conditions obtaining on the leaf surface. The next problem was to ascertain the function of Bordeaux mixture and so to settle which was the most useful of the possible basic sulphates. These salts are, of course, insoluble and have to be converted into a soluble substance before they can exert a fungicidal action. No evidence could be obtained that the plant leaf or the spore excreted anything that would dissolve an insoluble substance, but it was shown that the carbonic acid of the air decomposed these basic sulphates in accordance with the following reactions:—

(*a*) $10CuO,2{\cdot}5SO_3 + 3{\cdot}75CO_2 = 3{\cdot}75(CuO)_2,CO_2 + 2{\cdot}5CuSO_4$.
(*b*) $10CuO,2SO_3 + 4CO_2 = 4(CuO)_2,CO_2 + 2CuSO_4$.
(*c*) $10CuO,SO_3 + 4{\cdot}5CaO = 4{\cdot}5(CuO)_2,CO_2 + CuSO_4$.
(*a*) $10CuO,SO_3,3CaO + 7{\cdot}5CO_2 = 4{\cdot}5(CuO)_2,CO_2 + 3CaCO_3 + CuSO_4$.

The copper sulphate thus liberated constitutes the active part of the mixture. It acts in two ways. It directly poisons the fungus cell developing from the spore. Some of it gets into the leaf, displacing a certain amount of iron and entering into a remarkable combination not yet investigated, which seems so long as it persists to afford the leaf immunity against fungal attacks. Further studies of this remarkable body will be awaited with interest; it will be remembered that Church isolated a pigment *turacin* containing copper from certain genera of the family Musophagidæ, but no such pigment is known in the vegetable kingdom up to the present. But to return: the object of the fungicide is to furnish a steady supply of copper sulphate, and therefore the compound (*a*) is the most efficient of the series. In the case of (*d*), the ordinary Bordeaux mixture, a secondary reaction sets in between the calcium carbonate and the copper sulphate which further reduces its efficiency. (*a*) is, however, physically less suitable than (*c*). The whole leaf surface of the tree has to be covered with the mixture, and consequently the more bulky the mixture the better; since (*c*) occupies more than four times the volume of (*a*) it makes the most economical fungicide in practice. From the fruit-grower's point of view this compound has the further advantage that it can be made on the commercial scale and sent out as a paste ready for use. The paste has been extensively tried in orchards, with results that have completely confirmed the laboratory experiments. Several interesting side-issues were followed up. Some of the compounds in the ordinary Bordeaux mixture and in the so-called soda Bordeaux, obtained by mixing copper sulphate and sodium carbonate, contain copper in the electronegative condition, *i.e.* in the acid radical, and were called cupricarbonates; they appear to have no fungicidal action, they combine with cellulose, and slowly decompose to form cuprous oxide.

The report will be found one of the most interesting that has issued from Woburn. E. J. R.

UNDERGROUND TOPOGRAPHY IN IRELAND.

THE exploration of caves has become an athletic pursuit for certain enthusiastic specialists, perhaps as a complement to mountain-climbing. The results, however, have distinct scientific value, when careful plans of the caves are made, and underground waterways are traced. Attention has been directed in these pages to the economic bearing of "spelæology" in the Juras, and the work of the geographer is obviously incomplete, if his streams terminate, as so often happens, in swallow-holes in a limestone area, while others appear freshly on the surface, but may prove to be old friends returning to the upper world. Cave-research is arduous and often dangerous, and the wonder is that such accurate observations are provided for us by men who have to work under cramped conditions, and sometimes liberally immersed in water.

The Royal Irish Academy (Proceedings, vol. xxvii., section B, 1909) has recently issued two geographical memoirs on Irish caves. The first (pp. 183–192, price 6*d*.) is by Mr. Harold Brodrick, on "The Marble Arch Caves, County Fermanagh: Main Stream Series." The principal cave was explored and described by M. Martel some twelve years ago, with the assistance of the Irish naturalist, Dr. H. Lyster Jameson. Mr. Brodrick, with Dr. C. A. Hill, Mr. R. Lloyd Praeger, of Dublin, and other workers, was able to devote a longer time to the exploration of the district. The training and experience gained by most of the party in Yorkshire enabled them to add many new points to the topography of the area. As Mr. Brodrick remarks, the Marble Arch cave will "probably never become a show-cave, as the climb from the foot of the Great Boulder Chamber to the end of the Pool Chamber Passage is not one to be rashly undertaken." The by-paths of the recent exploration led the adventurers into several difficult places, not to speak of waters, where few will care to follow them. A large-scale map is provided, on which, however, the names used in the text are not always to be found.

The second paper (pp. 235–68, with four plates, price 1*s*. 6*d*.), on "The Mitchelstown Caves, County Tipperary," has a wider general interest. The authors are Messrs. C. A. Hill, H. Brodrick, and A. Rule; but Mr. R. Lloyd Praeger took part in the exploration. The New Cave, between Mitchelstown and Cahir, is probably the best-known cave in Ireland; but the plan now given of it seems to be far more accurate than that published by M. Martel, and includes several passages and chambers previously unrecorded. The work may not have been so exciting as that among the unfathomed waterways of Fermanagh, but one and a half miles of cave and passage have been mapped out. A curious point is that the names "Demon Cave" and "Victoria Cave" were found chalked up in some of the unrecorded portions, and these have been adopted in the plan. The names in this plan, by the bye, require one or two corrections to bring them into agreement with the text. The account of the New Cave might have been rendered even more complete by a reference to Prof. Carpenter's paper on its fauna in the *Irish Naturalist* for 1895.

Still more interesting is the description of the smaller Old Cave, which had apparently not been visited by tourists since 1833. The plan now given, covering 479 yards of cave and passage, is the first that has been made.

The clay of the cave-floors, which, as all visitors know, renders them unpleasantly slippery, is described on p. 267 as derived by inwashing from the Old Red Sandstone; but the quartz crystals noted in it, which are so common in the Carboniferous Limestone, and its general character as a *terra rossa*, make it

nmensely more probable that it is a residue from olution of the limestone.

The paper is well illustrated, and one photograph hows an "anemolite," or stalactite the growing tip f which has been bent sideways by the action of air-urrents.

Mr. Brodrick has also published a general account f the explorations in Fermanagh in the Yorkshire Ramblers' Club Journal. G. A. J. C.

NOTES.

THE following fifteen candidates have been selected by he council of the Royal Society to be recommended for lection into the society:—Mr. J. Barcroft, Prof. G. C. ourne, Prof. A. P. Coleman, Dr. F. A. Dixey, Dr. . N. G. Filon, Mr. A. Fowler, Dr. A. E. Garrod, Mr. . H. Hardy, Dr. J. A. Harker, Prof. J. T. Hewitt, rof. B. Hopkinson, Dr. A. Lapworth, Lieut.-Colonel Sir . B. Leishman, Mr. H. G. Plimmer, and Mr. F. Soddy.

INVITATIONS have been issued to meet the general board f the National Physical Laboratory at the laboratory on riday, March 18, when the various departments will be pen for inspection, and apparatus will be on view.

SIR VICTOR HORSLEY, F.R.S., has been elected a foreign ssociate of the French Academy of Medicine.

DR. W. F. HUME has been appointed director of the eological Survey of Egypt.

MR. ANDREW CARNEGIE has offered (the *Times* states) give a prize of 500*l.* to the first student of the Carnegie chool of Technology at Pittsburg who constructs an ëroplane satisfying certain conditions.

THE Friday evening discourse at the Royal Institution n March 11 will be delivered by Dr. H. Brereton Baker n "Ionisation of Gases and Chemical Change," and on larch 18 by Sir J. J. Thomson on "The Dynamics of a olf Ball."

THE death is reported, at the early age of thirty-three, f Mr. J. F. Ferry, for many years an ornithologist in onnection with the Field Museum, Chicago. In collect-ig for that museum he made expeditions among the lands of the Caribbean Sea and along the coast of the ulf of Mexico. He also carried out investigations in rizona for the U.S. Biological Survey, and in the moun-ains of California for the Smithsonian Institution.

THE following appointments have been made recently by he governing body of the Lister Institute of Preventive ledicine:—Mr. H. R. Dean and Dr. G. H. Macalister, ssistant bacteriologists to the institute; Dr. H. McLean, nior assistant in the bio-chemical department; Mr. shley Cooper, Jenner memorial research student; Mr. oland V. Norris, Grocers' Company research student; r. S. G. Paine, research student in the chemical depart-ent.

THE annual conversazione of the Selborne Society was ld in the theatre and halls of the Civil Service Com-ission on Friday, February 18. Sir John Cockburn, .C.M.G., gave an address on the objects of the society id the aims of its members, while Mr. E. J. Bedford tured on "Gilbert White and his Associations with lborne." Among the interesting exhibits was a working odel of a pole-lathe still in use for turning bowls in Berk-ire, which was made and exhibited by Mr. William ıwrence. The number of microscopes shown amounted one hundred, and the evening was probably the most ccessful yet arranged.

THE Geologists' Association is making arrangements for an Easter excursion to north Devon. It is intended that the excursion shall last from March 24 to March 30, and be under the directorship of Messrs. J. G. Hamling and Inkermann Rogers. The official party is to leave Paddington by the 1 p.m. train on March 24 for Barn-staple. On successive days the Upper Culm Measures, the Upper Devonian, the Lower Culm, and the Lower Devonian are to be studied in different districts. Full particulars as to the excursion can be obtained from Mr. Mark Wilks, 47 Upper Clapton Road, London, N.E.

THE Blue Hill Meteorological Observatory, situated near Boston, U.S.A., has just completed an existence of a quarter of a century. Founded and maintained by Prof. A. Lawrence Rotch, detailed measurements of cloud heights and velocities were early conducted, and in 1894 the first meteorological records in the world were obtained with kites at this station. These were extended ten years later with sounding balloons to great heights above the centre of the American continent, and, through the co-operation of M. Teisserenc de Bort, over the Atlantic Ocean (NATURE, vol. lxxiii., pp. 54–6, 449–50; vol. lxxx., pp. 219–21). These observations in the free air, like those made elsewhere in the interest of aërology for the International Commission for Scientific Aëronautics, have now become useful to aëronauts and aviators.

PROF. W. KRAUSE, whose death was recently announced from Berlin, at the age of seventy-six, was one of the better known of modern German anatomists. He was a son of the famous Dr. Carl Krause, professor of anatomy in the University of Hanover, who published a remarkable text-book of anatomy—"Handbuch der menschlichen Anatomie"—in 1833. The preparation of the third edition of this work, from 1876 to 1880, constitutes one of the most important contributions made to anatomy by the late Prof. W. Krause. His researches on the terminal organs (end-plates) of motor nerves gained him an early and wide reputation among histologists. Originally pro-fessor of anatomy in the University of Göttingen, he went, late in life, to Berlin, where he occupied the position of head of the anatomical laboratories of the University, under the directorship of the veteran anatomist, Prof. Waldeyer.

FEBRUARY was a stormy and unsettled month over the whole of the British Islands, and the total rainfall was large. At Greenwich the mean temperature for the month was 42·1°, which is 2·3° warmer than the average of the previous sixty years; the mean of the day readings was 48°, and the mean of the night readings was 36°. Frost occurred in the screen on seven nights, but on the grass in the open on fifteen nights. The aggregate rainfall at Greenwich was 2·72 inches, which is 1·23 inches more than the average; rain fell every day with three exceptions. February was wetter than any corresponding month during the last ten years. The sun was shining for seventy hours, which is thirteen hours in excess of the average. Cyclonic systems traversed our islands with great frequency during the month, the central areas following a track well to the northward, so that westerly winds greatly predominated. The Meteorological Office, alluding to the violent gale which occurred on Sunday, February 20, mentions that the squalls reached "storm" force in many parts of the country, and "hurricane" force at Southport, Scilly, and Pendennis Castle. The maximum velocity of the wind at Southport was at the rate of more than eighty-five miles an hour, using the new factor for the wind velocity as determined by the Meteorological Office.

The Royal Meteorological Society held its first meeting out of London on Wednesday, February 23, in the physical laboratory of the Manchester University. Dr. Hopkinson, the Vice-Chancellor, expressed the gratification the University felt at receiving the fellows of the society. He said that the history of the University showed that they were not merely in expression, but in act, interested in this branch of scientific work, as much had been accomplished in meteorology by the work initiated and supported by Dr. Schuster. Dr. A. Schuster also welcomed the society, and said that, although meteorology in itself might be regarded by some as a small part of physical science, yet it was intimately connected with a number of other subjects, especially with one large subject which he thought had received far too little attention in the universities, namely, the whole physics of the globe.

We learn from *Science* that the board of managers of the National Geographic Society has adopted the following resolutions:—"The National Geographic Society believes that it is of importance to science that tidal, magnetic, and meteorological observations shall be obtained at or in the vicinity of Coats Land during the same period that the British expedition under Captain R. F. Scott, R.N., is making similar observations on the other side of the Antarctic area, 1800 miles distant, and at the same time that this recently discovered land shall be explored. That the society is ready to accept Mr. Peary's proposition that it shall undertake jointly with the Peary Arctic Club an expedition to the Antarctic regions as outlined above, provided that the board of managers, after consultation with the members of the society, finds that the project will receive sufficient financial assistance to warrant the undertaking."

Dr. Charcot gives in the Paris edition of the *New York Herald* an account of the scientific work accomplished by his recent Antarctic expedition. He says that during the whole duration of the expedition, both while in winter quarters and during the two voyages, the scientific work was carried out unceasingly. During the whole of the voyages oceanographic soundings were taken and dredgings made. At the same time hydrographic and meteorological observations were made, and natural-history studies effected. These were also carried out while in winter quarters. Very complete maps were made of the regions seen from the coasts, and astronomical observations and studies in terrestrial gravitation were carried out at numerous stations. The seismograph was at work in the winter quarters and on Deception Island. Observations in meteorology, atmospheric electricity, and physical oceanography, including numerous soundings, were carried on almost continually while the expedition was in winter quarters.

The thirty-second annual general meeting of the Institute of Chemistry was held on Tuesday, March 1, Dr. George Beilby, F.R.S., president, in the chair. In moving the adoption of the report of the council, Mr. David Howard alluded especially to the new requirement in the final examination of a useful knowledge of French and German. He believed that this addition would prove of great benefit to chemists, and he knew that it could be left to the examiners to apply the test of this knowledge humanely. They did not want school, commercial, or legal French and German, but a useful knowledge sufficient to enable them to consult technical literature in those languages. Dr. Beilby then delivered his address. He remarked that the institute had undoubtedly influenced the teaching of the universities and colleges, and had endeavoured to encourage the production of men who could not only talk about chemistry, but were able to apply their knowledge usefully. In moving a vote of thanks for the address, Sir William Ramsay said he was inclined to think that the tendency was to trust too much to the results of examinations. He was of opinion that the aim of the examiners should be to ascertain if the candidates could converse freely and easily on their subject and put it into practice.

A prize of 3000 lire (about 120*l.*) is to be awarded by the section of physical sciences of the Royal Academy of Bologna. The competition is an international one, and the prize is due to a generous donation to the section by a corresponding member, Prof. Elia de Cyon. The object of the competition is to further researches and studies in the subjects which he took up with much success. The subjects of the works submitted for the prize are to have reference particularly to:—(1) the functions of the heart, and especially of the nervous, cardiac, and vaso-motor systems; (2) the functions of the labyrinth of the ear; (3) the functions of the thyroid gland, the hypophysis, and the pineal gland. The works submitted must be of recent date, in the case of the present (the first) competition not prior to March 1, 1909. Memoirs may be written in Latin, Italian, French, German, or English. Competitors may be called upon to repeat their experiments in the presence of the three members of the adjudicating committee. The prize will not be divided, and may not be conferred more than once upon the same person. The section of physical sciences reserves the right to publish the successful paper in its Transactions. No member o the section is eligible for the competition. Further par ticulars may be obtained from Il Segretario, Classe d Scienze Fisiche, R. Accademia delle Scienze, Bologna.

In our issue for December 23 last we recorded Mr. Ott Beit's munificent gift of 215,000*l.* for the foundation an endowment of medical research scholarships. The trustee of the fund met on February 23, and awarded the first se of the fellowships. Seventy applications were received— fifty-eight from England, three from Scotland, one fron Ireland, one from Wales, and seven from abroad. Th following fellows were elected, and were authorised t proceed with the researches mentioned after their names:— Mr. G. H. Drew, the zoological distribution of cancer an a systematic study of an experimental character on th mode of origin of neoplasms (tumours); Dr. F. W Edridge-Green, various problems connected with vision an colour-vision, especially in relation to the correct readin of signals on land and sea; Mr. E. Hindle, the morpholog and treatment of protozoic blood parasites, especiall *Spirochaeta duttoni* and trypanosomiasis (sleeping sick ness); Dr. T. Lewis, the mechanism of irregularities c the heart; Dr. G. C. McKay Mathison, (*a*) the nervou control of respiration, and (*b*) the effect on respiration c changes in the chemical composition of the blood; (*c*) th mechanism of biliary secretion and its general effect i digestive processes; Dr. Otto May, clinical and exper mental research on the lesions of peripheral nerves; M E. Mellanby, the significance of the large excretion c creatin in cancer of the liver and its diminished excretic in cirrhosis of the liver, &c.; Dr. F. P. F. Ransom, th mode of action of caffeine, theobromine, and allied su stances on the muscular and nervous systems; Dr. S Russ, the association of radio-activity with cancer; D Ida Smedley, the processes involved in the formation c fat in the organism. The next election of fellows will b held about December 15 next. All inquiries should b addressed to the honorary secretary, Beit Memori Fellowships for Medical Research, 35 Clarges Stree Piccadilly, London, W.

THE death is announced of M. Philippe Thomas, the eminent and enthusiastic geologist who did important pioneer work in Tunis and Algeria. Born at Duerne (Rhône) in 1843, he entered the veterinary school at Alfort in 1860, and became a prominent member of the French army veterinary service, from which he retired about nine years ago. From his earliest youth he was deeply interested in geology, and when his official appointment took him to Algeria he devoted his scanty leisure to the study and collection of the rocks and fossils of that country, and was especially eager in the search for evidence of primitive man. During twenty years he published a series of notes and papers on subjects ranging from man and Tertiary vertebrates to the stratigraphy of the region. In 1884 he was chosen by the Minister of Public Instruction to join the well-known scientific mission to Tunis as one of the geologists, and there he had ample scope for the exercise of his abilities. He discovered the immense deposits of phosphatic chalk, which have subsequently proved of so great economic importance to Tunis. He amassed material for an exhaustive description of the geology of the country, and his later years were occupied with its preparation for publication. Unfortunately, only two parts of this work appeared, and the third part, dealing especially with the phosphatic deposits, remained unfinished at the time of the author's death.

AN appreciative account of the scientific work of Mr. Edward Saunders, F.R.S., who died, we regret to learn, on February 6, in his sixty-second year, appears in the March number of the *Entomologist's Monthly Magazine*, of which he was an editor. From this notice we extract the following particulars of Mr. Saunders's career:—Edward Saunders devoted himself first to the Coleoptera, but acquired also considerable familiarity with entomology in general, and with several other of the "systematic" sciences, such as botany and conchology. At the age of sixteen he published a paper in the first volume of the *Entomologist's Monthly Magazine* on Coleoptera at Lowestoft, and was afterwards for some years mainly occupied in studying the Buprestidæ of the world. A succession of notes, descriptions, revisions of particular collections, groups, &c., bearing on this subject were communicated by him to the Transactions of the Entomological Society from 1866 to 1869; in 1870 he published a "Catalogue of the Species contained in the Genus Buprestis, Linn.," and in 1871 his "Catalogus Buprestidarum Synonymicus et Systematicus," a work the importance of which was immediately recognised. From 1872 to 1874 he continued his work on this group, describing several new genera and more than a hundred new species, and at the same time began to issue a long series of notes on British Hemiptera, which were followed in 1875–6 by a synopsis, in three parts, of the British Hemiptera-Heteroptera, and this again by a large illustrated volume, his well-known "Hemiptera-Heteroptera of the British Isles," which was published in 1892. Concurrently with this important mass of work on two distinct orders of insects he began to attack a third group, the Aculeate Hymenoptera, to which he gradually transferred his chief attention. For the rest of his life the Aculeates (especially the British species) became his favourite study, and he ultimately became, not merely the foremost, but, it may almost be said, the final authority upon the latter. His grand work "The Hymenoptera-Aculeata of the British Isles" (1896) is one of the few without which no serious hymenopterist thinks his working library complete. Saunders became a Fellow of the Entomological Society in 1865, served as treasurer from 1880 to 1890, and was a vice-president in no fewer than five sessions, viz. in 1874, 1899, 1901, 1906, and 1907. Though he never actually held the presidency, it is scarcely a secret that he would more than once have been elected to it unanimously if he could have been persuaded to accept a post the duties of which he felt unequal (physically) to discharge so completely as he would have wished. He entered the Linnean Society in 1869, and about that time contributed at least three papers to its journal. Long after, in 1890, he published in the same journal an exceedingly careful and interesting paper on the tongues, &c., of bees, with beautiful illustrations, drawn by his brother, Mr. G. S. Saunders, from microscopic preparations made by Mr. Enock. His election in 1902 to the honour of fellowship in the Royal Society was not only highly gratifying to himself and his personal friends, but to all who saw in it a recognition of systematic entomology, treated as Saunders treated it as no mere idle dilettantism, but a genuine branch of science.

ONE of the features of the fauna of continental Africa is the absence of flying-foxes of the typical genus Pteropus, this absence extending also to the island of Zanzibar. On the other hand, representatives of these bats occur in Madagascar and the Mascarene, Comoro, and Seychelles group. Recently, specimens of a new species of flying-fox have been obtained from the island of Pemba, which lies to the north of Zanzibar at a distance of only about 37½ miles from the mainland. That the genus should be found so close to the African continent, and yet should never have reached the same, is very remarkable, especially when the long interval between the Comoros and Seychelles, on the one hand, and the Andamans and Ceylon, on the other, is borne in mind. The Pemba species, which is described by Dr. P. Matschie in the *Sitzungsberichte Ges. naturfor. Freunde*, Berlin, 1909, p. 482, belongs to the short-nosed group of the genus distinguished as Spectrum, and has been named *Pteropus voeltzkowi*.

IN vol. xxxii., part i., of Notes from the Leyden Museum, Dr. F. A. Jentink describes a new bat from Java, and at the same time proposes the name Chrysopteron for the Celebesian *Cerivoula weberi* and the new species, which are regarded as constituting a genus by themselves. The typical plantain-bats of the genus Cerivoula (Kerivoula) are characterised by the normal form of the upper canines and the tricuspid first pair of lower incisors; a second genus, Phoniscus, as represented by *P. atrox* of Sumatra, differs by the elongation and compression of the shaft of the upper canines and the quadricuspid first lower incisors, while the new genus is characterised by the presence of four cusps to both first and second lower incisors. It may be pointed out that Chrysopteron, which includes the Celebesian *C. weberi* and the Javan *C. bartelsi*, is practically identical with the much earlier name Chrysoptera.

CONSIDERABLE interest attaches to two papers, by Mr. Knud Andersen, in the January number of the *Annals and Magazine of Natural History* on the African fruit-bats of the Epomophorus group. Hitherto, with the exception of *Hypsignathus monstrosus*, all these bats have been very generally included in the single genus Epomophorus. The author shows, however, that the Angolan *E. anchietae*, on account of possessing $\frac{4}{6}$ pairs of cheek-teeth (in place of the usual $\frac{5}{6}$), the great width of the palate, and other cranial characters, is entitled to rank as a genus by itself, for which the name Plerotes is proposed, this genus being intermediate between Rousettus (cheek-teeth $\frac{5}{6}$) and Epomophorus. Next to Plerotes comes the genus Epomops, as represented by *E. franqueti* and *E. comptus*, in which

the muzzle and palate are also wide, although somewhat less so than in the Angolan genus, the hind portion of the palate retaining the flattened form characteristic of Rousettus and its allies. In Epomophorus, on the other hand, the palate is narrow and deeply hollowed out behind, thereby differing from the same region in all other members of the fruit-eating group. Lastly, we have the genus Micropteropus, characterised by the extreme shortness of the skull, which approximates in this respect to that of Cynopterus.

A short paper on the gametophytes of the orchid, *Calopogon pulchellus*, is contributed by Miss L. Pace to the *Botanical Gazette* (August, 1909), which adds to the gradually accumulating information regarding developmental details of the megasporangium. The formation of a single sporogenous cell, as generally observed, and absence of any parietal cells, coincides with the typical routine in orchids, but anomalous conditions appeared in several ovules where two mother-cells were found either contiguous or with nucellar tissue lying between. The figures are suggestive of two archesporia side by side, but the ultimate fate of these cells was not determined. Four megaspores were usually formed, although dividing walls between them were wanting; owing to disintegration of three of the nuclei, the chalazal nucleus alone persisted to become the nucleus of the embryo sac. Evidence in favour of double fertilisation is adduced.

A brochure dealing with the cultivation of fibre plants in India has been issued as Bulletin No. 15 of the Agricultural Research Institute, Pusa. There is a noteworthy division into peasants' crops, capitalists' crops, and fibres worth experimental attention. The first category comprises jute, *Hibiscus cannabinus*, *Crotalaria juncea*, and cocoa-nut; the second includes rhea, agave, Sansevieria, and flax, while plantain and sida fall into the third category. The cultivation of jute has not spread to any appreciable extent beyond the provinces of Bengal and Assam. *Hibiscus cannabinus* is preferred to jute in certain regions, notably the Vizagapatam and Kistna districts in Madras, because it requires less water. Sann hemp, *Crotalaria juncea*, thrives in districts of moderate rainfall; there is an established industry in the fibre in parts of the Central and United Provinces and of Assam, but the plant is more frequently grown to supply green manure or fodder.

The principal article in *Symons's Meteorological Magazine* for February is devoted to the "Proposed Imperial Meteorological Organisation," discussed at an informal conference of meteorologists at the Winnipeg meeting of the British Association last year. The circular letter drawn up by the committee then appointed for transmission to meteorological authorities of the British Empire, inviting cooperation in contributing data on a common plan for publication by a central agency, is reprinted, and states that, primarily, information is required as to pressure, temperature and rainfall, and their fluctuations from the normal, and it is suggested that the form adopted by the Solar Commission of the International Meteorological Committee, whose headquarters at the present time are in London, in connection with the Solar Physics Observatory, should be followed. Monthly tables relating to the climate of different parts of the British Empire have appeared in *Symons's Meteorological Magazine* for many years; the editor heartily welcomes the establishment of a more general system, under official auspices; at the same time, he does not think that a new system of expressing meteorological observations is desirable. The meeting at Winnipeg expressed an opinion in favour of the use of absolute units for pressure and temperature; for the present, however, the circular states, it is not proposed to ask the various authorities to come to any final decision upon the point.

From the February Bulletin of the American Mathematical Society we learn that the Göttingen Academy of Sciences has awarded 5*l.* to Dr. A. Wieferich, of Münster, who has shown that the equation $x^p+y^p=z^p$ cannot be solved in terms of positive integers, not multiples of p, if 2^p-2 is not divisible by p^2. The announcement is followed by the comment:—"This surprisingly simple result represents the first advance, since the time of Kummer, in the proof of the last Fermat theorem."

In the *Annals of Mathematics* (October, 1909) Mr. Frank Gilman discusses the theory of floating tubes as applied to the measurement of currents in open channels of water. The method was first described by Mr. T. A. Mann in a paper communicated to the Royal Society in 1779, and was used by R. T. Kraÿenheff in Holland (1813), M. de Buffon on the Tiber (1821), Destrem on the Neva (1835), and Francis in America (1852). The tubes ranged from 6 feet to 10 feet in length, and were allowed to float down the stream over a measured course of 70 feet. Other experiments mentioned are those of Captain Cunningham in India (1874–9), of which a detailed discussion is given in the paper, M. A. Graëff (1883), and Messrs. Humphreys and Abbot on the Mississippi River (1851–76).

The University of Illinois has established an engineering experiment station to carry on investigations along various lines of engineering. Especial attention has been paid to problems bearing on fuel, and the two last bulletins issued deal with this subject. The first of these, by J. M. Snodgrass, is on fuel tests with house-heating boilers. Central heating by steam is more common in the United States than in this country, but the figures given are not without interest over here. The fuels used, of which complete analyses are given, included anthracite, gas coke, bituminous coal, and briquettes of various kinds. The tests were very complete, and deal with questions of efficiency, cleanliness, cost of control, smoke, and soot. The boiler efficiencies determined varied from 45 to 66 per cent. The experimental data are discussed in a very complete manner, especially from the cost point of view. The only point open to criticism is the unnecessary number of significant figures in the experimental results. Thus we find the calorific value of a coal given as 14,229 B.T.U. per lb., and boiler efficiencies are given to 0·01 per cent. Three significant figures in the calorific value probably represent the limit of accuracy attainable in such experiments when the sampling difficulties are taken into account; an accuracy of 1 in 14,000 in a thermal measurement is certainly unattainable.

The second bulletin, by S. W. Parr and Percy Barker, deals with the occluded gases in coal. These experiments are of practical importance in two directions, first as bearing on the spontaneous combustion of coal, and secondly as showing how to prevent deterioration of stored coal. Coal commences to give off inflammable gases as soon as it is mined, and at the same time absorbs oxygen from the air, both these changes taking place with greater rapidity the finer the state of division of the coal, and both being almost entirely suppressed when the coal is submerged in water.

The *Zeitschrift für physikalische Chemie* (January 25) contains a paper, by J. T. Barker, on the determination of the vapour pressures of toluene, naphthalene, and

benzene at temperatures ranging from $-78°$ C. to $25.8°$ C. At the lower temperatures the statical method is not sufficiently exact, and hence the vapour pressures were measured by saturating pure oxygen, prepared electrolytically, with the vapour of the substance, the latter being maintained at a constant temperature. The amount of vapour carried away by the oxygen was determined by combustion, full details being given of the precautions necessary for exact working. The method was shown to be capable of measuring vapour pressures down to 0·005 mm. of mercury. The experimental results were compared with Nernst's formula for the calculation of vapour-pressure curves, and for toluene, naphthalene, and benzene; the agreement was found to be satisfactory.

An interesting article appears in *Engineering* for February 25 giving particulars of a new shrinking and tempering shop for guns at Woolwich Arsenal. Modern built-up guns have steel tubes and liners which require oil-hardening, and as these guns are sometimes of great length, it will be understood that adequate means must be provided for lifting the guns to considerable heights. It was decided that the new building should be 300 feet long in the clear (the first part to be constructed being 150 feet), 60 feet wide, and 90 feet high from the floor-level to the gantry rail. It was also stipulated that an electro-hydraulic travelling crane should be installed capable of lifting 120 tons, and of travelling with its load at a speed of 75 feet per minute, the speed of the cross traverse under similar conditions being 35 feet per minute. Another requirement of this crane is ability to lower a weight of 60 tons at a speed of 500 feet per minute, this being of great importance on account of the necessity of dipping the guns rapidly into the oil in the process of hardening. Two deep pits, each 11 feet in diameter, are provided for oil-hardening tanks; also one shallower overflow pit, a driving pit 18 feet in diameter with an anvil bottom, and a shrinking pit.

Messrs. Cassell and Company, Ltd., have commenced the publication, in fortnightly parts, sold at one shilling net each, of Mr. Richard Kearton's "Nature Pictures." The illustrations are beautifully reproduced, and are accompanied by descriptive text. The work will be completed in twenty-four parts, and we propose to review it when the serial publication is complete.

A second edition of an essay entitled "The Finest Walk in the World," by Miss B. E. Baughan, which originally appeared in the *Spectator*, and was published recently in pamphlet form with numerous illustrations, has been issued by Messrs. Whitcombe and Tombs, Ltd., of Addle Hill, Carter Lane, London. The walk, some thirty-three miles in length, is in the neighbourhood of the celebrated Milford Sound, in the south-west corner of New Zealand. Judging from the beautifully reproduced photographs and the enthusiastic descriptive text which accompanies them, the walk must reveal a succession of panoramic views of Nature at her loveliest.

The annual report of the board of regents of the Smithsonian Institution, showing the operations, expenditures, and condition of the institution for the year ending June 30, 1908, has been received. As usual, the general appendix of the volume, running to some 684 pages, will make the widest appeal to readers. It contains a representative selection of papers and addresses by distinguished men of science dealing with notable current scientific researches. Some of these are translations into English from German, French, and Swedish publications, others have appeared in Nature from time to time, and the remainder are from American and British authors, some being original, while others are reprints. The following contributions may be mentioned:—Sir Joseph Thomson's Adamson lecture to the University of Manchester, on the light thrown by recent investigations in electricity on the relation between matter and ether; Prof. J. W. Gregory's contribution to the Congrès géologique international, Mexico, 1906, on climatic variations: their extent and causes; Prof. J. Joly's address to the geological section of the British Association at Dublin in 1908, on uranium and geology; Captain H. G. Lyons's lecture to the Royal Geographical Society, on some geographical aspects of the Nile; Prof. Ronald Ross's address to the Oxford Medical Society in 1906, on malaria in Greece; and Prof. Silvanus P. Thompson's Kelvin lecture of 1908 (abridged and revised by the author), on the life and work of Lord Kelvin.

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in March:—

March 3. 12h. 0m. Venus stationary.

7. 0h. 39m. Uranus in conjunction with the Moon (Uranus 3° 34′ N.).

8. 9h. 17m. Venus in conjunction with the Moon (Venus 11° 52′ N.).

10. 6h. 0m. Vesta in conjunction with the Moon (Vesta 1° 9′ N.).

13. 2h. 45m. Saturn in conjunction with the Moon (Saturn 0° 58′ N.).

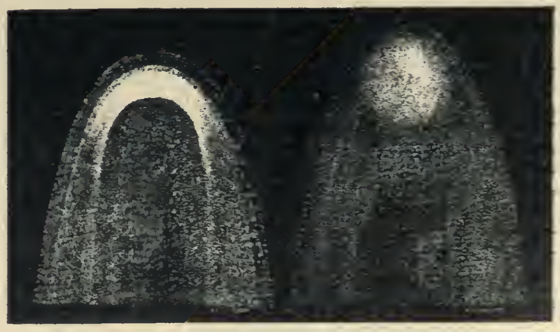
15. 19h. 17m. Mars in conjunction with the Moon (Mars 1° 16′ N.).

18. 17h. 0m. Venus at greatest brilliancy.

25. 18h. 21m. Jupiter in conjunction with the Moon (Jupiter 2° 31′ S.).

30. 18h. 0m. Jupiter at opposition to the Sun.

Comet 1910*a*.—In these columns last week reference was made to two drawings, of comet 1910*a*, which are now reproduced from the *Comptes rendus* (No. 7, p. 370, February 14). They were made by M. Esclangon, and illustrate the remarkable change which took place in the appearance of the comet's head between January 22 and 30.



January 22. January 30.

M. Esclangon points out that such apparent changes may be produced in two ways:—(1) by actual changes in the comet itself; (2) or by the different angles at which it is presented to the observer. While great real changes undoubtedly took place in comet 1910*a*, a certain proportion of the apparent change can be explained by the different aspect, for on January 22 the angle made by the tail with the line-of-sight (comet-earth) was 96°, whilst on January 30 it was 133°; but, apart from this, there was a real change in brightness and in the condensation of the nucleus consequent upon the comet's recession from the sun; on the former date its distance was about 0·25, on the latter about 0·55, astronomical unit.

M. J. Comas Sola also made a special study of the figure of the comet, and gives his results in the same

number of the *Comptes rendus.* He remarks that the tail was always bifurcated, as though the nucleus formed a screen to the repulsive force acting on the vapours, and at its greatest length extended to a distance of 50°. Photographs taken at the Fabra Observatory show the details very well, but are not suitable for reproduction. Special attention was paid to the secondary tail on the left of the comet, which was much fainter than the primary, and extended to the opposite side, that is, towards the sun. This tail was *concave* to the direction of the motion, and it is this point that M. Sola discusses. He attributes the concave form to the differential action of the gravitational forces of the sun and the nucleus and the repulsive action emanating from the sun. The greater number of particles are repelled and form the principal tail, but others, depending upon their nature, will not be driven away entirely, and will become attracted towards the sun. The finest of these will be disseminated into space, but the heavier ones will, in falling towards the sun, be attracted by the nucleus, and thus produce the observed form concave relatively to the comet's motion; those falling into the nucleus will be again expelled, but others of which the velocity sunwards is too great will rush past the nucleus and form the fan seen on the side of the head nearer the sun. This hypothesis admits of two tests:—(1) before perihelion the concavity should not precede the nucleus; (2) spectroscopic investigation should show the two tails, at a distance from the nucleus, to differ chemically. M. Sola gives a formula by which the acceleration of the different particles might be computed on the assumption that the forces he assumes are all active, but the photographs of comet 1910*a* do not permit of its application.

FIREBALL OF FEBRUARY 17.—Mr. W. F. Denning writes:—"A considerable number of reports have been received concerning the appearance of this brilliant object. It was seen so far east as in Essex and Kent, and observers in Gloucestershire, Somerset, Devon, and Glamorgan witnessed the descent of the fireball under a more brilliant aspect. The long endurance of the trail was one of the most noteworthy features, and reminds us of the remarkable meteor of February 22, 1909, which left a streak for three hours.

"From the best observations it appears that the fireball of February 17 last descended in a nearly vertical path over a point about twenty miles north-west of Land's End, Cornwall. That its height was approximately eighty-eight to forty-six miles appears very probable, but observations would be valuable from Cornwall and the south coast of Ireland.

"To have created so brilliant an effect in the evening twilight the meteor must have been one of the very largest type, and the shower in Auriga from which it was presumably directed is one of extremely interesting character. Meteors of great size and startling brilliancy are more frequent in the early evening than at any other period of the night, and this is a circumstance to which the writer has several times directed attention."

It is reported that a brilliant meteor, as bright as Venus, was seen from many parts of Yorkshire soon after sunset on Tuesday last, March 1.

HALLEY'S COMET.—In an article on Halley's comet which appeared in the *Times* of February 24, the writer states that the comet is likely to be at its best, as a display, during the last ten days of May, when it will be an evening star and near to the earth. He also suggests that between March 11 and April 24 the comet will probably be unobservable, being too near the sun as seen from the earth. On the latter date it should become visible as a morning star, rising just before dawn; but while its intrinsic light will then be nearly at its maximum, its apparent brilliancy will suffer on account of the distance from the earth. After the transit on May 18, the comet will again become an evening star, and, being then much nearer the earth, should be seen at its best. During the transit Mr. Evershed is hoping to employ both heliograph and spectroheliograph at the Kodaikanal Observatory to obtain records of the comet's nucleus. That this contains a large amount of solid matter is rendered probable by the endurance of the comet for at least 2000 years; simple vapour would scarcely hold together for so long, and could not be expected to disseminate and lose entirely the amount of matter that has been poured forth by Halley's comet even during its known career. A photograph taken at Greenwich Observatory on January 30 showed a fairly defined nucleus surrounded by a large diffused coma, and a very faint tail.

PIDOUX'S COMET, 1910*b*.—No further official news of the comet discovered by M. Pidoux at Geneva on February 20 is to hand, nor had any further observations been reported to the *Astronomische Nachrichten* up to February 25; but according to a Geneva correspondent of the *Daily Chronicle* M. Pidoux discovered the new comet photographically whilst photographing Halley's comet, and confirmed the discovery visually. He says the new comet is V-shaped, and travelling at a great speed in a south-west direction; also that it is brightening, and, given good weather, should become a naked-eye object in a few days. No magnitude is mentioned.

A NAKED-EYE SUN-SPOT GROUP.—A remarkable group of spots has been observed on the solar disc during the past fortnight. Following a pair of spots of moderate size, a small spot was seen to come round the eastern limb on February 17, and on February 19 developed into a group. This group increased in numbers and extent until, on February 23, the length of the affected area, measured along the greatest diameter, was about one-seventh of the solar diameter, roughly 120,000 miles. On March 1 most of the group had passed over the western limb, and there was a low bank of prominence matter, seen in the C line of hydrogen, lying above its position on the limb. The visual observations at the Solar Physics Observatory, South Kensington, showed that a little to the north of the spot disturbance there was a bright trifurcated prominence on the limb, which changed its form considerably between 10 a.m. and 1 p.m. Mr. J. H. Elgie reports having seen the above spot group with the naked eye on February 25.

THE BRENNAN MONO-RAIL SYSTEM.

A LARGE company of engineers and others interested, including representatives of the Admiralty and of the War Office, assembled at the Brennan Torpedo Works, near Chatham, on Friday, February 25, to witness a demonstration of Mr. Brennan's mono-rail vehicle. The vehicle shown, which is the first of its kind, has been designed for rough military purposes, not for high speeds, and the trials on this occasion were intended to show its adaptability for this kind of work. A general description of the car and the experimental track appeared on p. 79 of our issue for November 18, 1909, to which we may refer our readers, supplemented with the illustration now shown of the vehicle standing on one of the sharp curves. In this illustration may be noticed the radiators for cooling the circulating water required for the petrol motors, these radiators being secured to the front of the machinery cab; the front bogie with its two wheels, the rear wheel being driven by side rods and balanced cranks from one of the two electromotors; also one of the side chocks, on which the car may rest when required for unloading or other purposes. There is a chock on each side of the car. Mr. Brennan is the centre figure in the machinery cab.

The car first made its appearance from the pier, carrying a number of large packing cases and three or four men, and was brought to rest. Then, running on to the circular track of 105 feet radius, the speed was gradually accelerated to twenty miles per hour, the car inclining inwards automatically so as to counteract the effect of centrifugal force. It is of interest to note that the load was simply laid on the flat platform of the car, without being secured in any way, and that there was not the slightest tendency to disturb the position of any of the packing cases while on the curve, thus showing the perfect balance maintained by the gyroscopes. While stopping on the curve, the angle of heel gradually diminished, and the car platform was level on rest being attained.

The operation of unloading in the field was then shown. While the normal action of the gyroscopes is to maintain

he car platform level, the driver can exercise control so ıs to cause the platform to incline to either one side or he other. With the car at rest on the curve, some packng blocks were laid on the ground reaching to within ıbout a foot of the chock on one side of the car. The lriver then inclined the car so that the chock rested on he packing blocks; some planks were laid resting on the ground at one end and against the car platform at the ther, so as to extend the inclined plane of the platform lown to ground-level. The packing cases were then asily shoved off without the assistance of any tackle vhatever. On unloading being completed, the driver aused the car to recover level immediately. Mr. Brennan ıas not yet published a complete description of the nechanism for bringing the gyroscopes back to their entral position, certain patents having been applied for ınd not yet granted.

We then had an opportunity of taking a run round the ircle. All passengers stood, and, despite the fact that here was nothing to take hold of, perfect steadiness of

The Brennan Mono-Rail Vehicle.

quilibrium was experienced by everyone. The angle of ıeel inwards we estimated to be about 10 degrees on this rip. An exhibition of the vehicle taking sharp curves ollowed, the minimum radius being 35 feet, after which ve had a trip at high speed down the straight portion of he track and back again. Complete success attended all he trials, and Mr. Brennan is to be heartily congratulated n the results.

From our previous description of the track it will be ınderstood that its simplicity renders it very suitable for nilitary purposes. The short cross-sleepers are simply aid on the ground without ballast, and we noted on this isit that, at one part of the straight line, longitudinal leepers had been used. At the factory entrance a short art of the line is flush with the surface of the macadam, llustrating the value of the system for tramway work. t is intended to put in hand one or more trailers to be oupled to the present vehicle, in order to show the racticability of running such vehicles on trains.

THE FUEL QUESTION IN THE UNITED STATES.

AN important department of the United States Geological Survey is that devoted to fuel. More than 400,000,000 tons of coal, valued at above 106,000,000*l.*, were raised in 1908, nearly the whole of which was consumed in the country, and this department has made numerous researches as to the best methods of utilising this coal. The information acquired is published from time to time in the form of bulletins, most of which are supplied free or at a nominal cost. Four bulletins recently issued, Nos. 373, 382, 383, and 385, may be taken as indicating the scope of the work done. They are entitled "The Smokeless Combustion of Coal in Boiler Plants," by D. T. Randall and H. W. Weeks; "The Effect of Oxygen in Coal," by D. White; "Notes on Explosive Mine Gases and Dusts," by R. T. Chamberlin; and "Briquetting Tests at the United States Fuel-testing Plant, Norfolk, Virginia, 1907–8," by C. L. Wright. The paper on briquetting is chiefly of interest to the mine-owners and coal-users of Virginia, although the summary of the recent literature on briquetting possesses a wider value. The work described by R. T. Chamberlin in the memoir on explosive mine gases and dusts had only just commenced when, in December, 1907, a series of unusually disastrous explosions took place in the Naomi, Monogah, and Darr mines of Pennsylvania and West Virginia. This led to a diversion of the original inquiry, the gas and dust concerned in these explosions being subjected to a detailed examination. Special attention was given to the part played by the methane evolved from the coal in the production of these explosions, this gas being more rapidly evolved the finer the state of division of the coal. After this emission of methane had gone on for some time the dust was less readily ignited, and experimental evidence is given showing that the fresh dust is more dangerous than old dust.

The memoir by Mr. D. White, on the effect of oxygen

in coal, proves, from the calorimetric point of view, that high oxygen is practically equivalent to high ash. It is also shown that the ratio of hydrogen to oxygen is the best measure of the coking efficiency of the coal, and the effect of the oxygen on the weathering of the coal is also discussed.

The bulletin by Messrs. D. T. Randall and H. W. Weeks, on the smokeless combustion of coal in boiler plants, is of especial interest in the United States, where the regulations against the production of smoke are severe, and strictly enforced. Between 400 and 500 steam plants in thirteen of the larger cities were visited, the data from 285 plants being made use of in this report. The general conclusion is that the smokeless combustion of bituminous coal is possible, and there are many types of furnaces and stokers that are operated smokelessly. The guiding principle is that stokers or furnaces must be set so that combustion is complete before the gases strike the heating surface of the boiler. The plant must be designed for the type of coal it has to burn; no one type of stoker is equally valuable for burning all kinds of fuel. It is worthy of note that, among the numerous stokers described, no mention is made of boilers using powdered fuel, a type particularly well adapted for the smokeless combustion of bituminous coal. The amount of experimental work given is very large, no fewer than fifty-seven tables of results accompanying the text. It is a work which should be in the hands of every engineer responsible for a steam plant. At the end of the bulletin is a bibliography of the survey publications on coal and fuel testing, and also of publications on smoke abatement.

THE SCIENTIFIC REPORTS OF THE LOCAL GOVERNMENT BOARD.[1]

WHEN science as a whole is neglected by our Government, it is satisfactory to find that one Government Department at least is alive to the value of scientific research, and is able by annual grants to investigators to assist research and to produce the admirable work contained in the reports under review. It may be hoped, apart from other considerations, that the example of the Local Government Board may serve a useful purpose in encouraging similar work by other Government Departments. These reports of the Medical Officer of the Board are now being issued much earlier than previously, a fact of moment, for the practical value of a research is often diminished by delay in publication.

Dr. Andrewes furnishes a second report on the bacteria of sewer air. He finds the bile-salt neutral red lactose agar medium of McConkey well fitted for the detection of bacteria belonging to the *B. coli* group. In the drain air of a large public institution and of a private dwelling sewage bacteria can be readily demonstrated, but their presence is of a highly intermittent character. The determining cause of the access of sewage bacteria to drain air appears to be droplet contamination from splashing. Dr. Andrewes and Dr. Horder have continued observations on the defences of the body against the pyogenic cocci, commenced last year by Drs. Andrewes and Gordon, and their joint report contains matter of much interest.

In view of outbreaks of cerebro-spinal fever, Drs. Gordon and Horder investigated the relative efficacy of the various anti-meningococcus sera on the market; the sera tested on animals possessed practically no curative or prophylactic value. Treatment with a vaccine, however, gave some promising results. It is to be noted that Flexner and Jobling have obtained very encouraging results in the treatment of epidemic cerebro-spinal fever in man with anti-meningococcus serum.

Dr. Savage submits reports dealing with mastitis in cows ("garget"). Some 70–75 per cent. of the cases are associated with a streptococcus having special characteristics, and termed the *S. mastitidis*; but it is significant, and throws doubt on the specificity of the organism, that the same streptococcus was found in milk from unaffected quarters of the udder. The explanation may be that, as in other microbial diseases, the organism becomes pathogenic only under special conditions. The streptococci present in cases of human sore throat were also investigated, and were found to be of the *S. anginosus* type.

These two streptococci, morphologically and culturally, are indistinguishable, but show marked differences in their pathogenicity on animals. Thus the mastitis variety is non-virulent to mice and other rodents, but is capable of inducing a mastitis in goats; the anginosus variety, on the other hand, is virulent to mice, but fails to induce mastitis in goats. Dr. Savage therefore suggests that it may be possible to determine whether streptococcal outbreaks of human throat disease are due to milk by the capacity of the streptococci of the human disease to cause mastitis in goats by infection of the teats.

Dr. Savage has also continued his investigations on the cultural reactions and on the presence of bacilli of the Gärtner group in the intestinal tract of animals, and in a second report discusses the presence of paratyphoid bacilli in man. It is pointed out that the hog-cholera bacilli are indistinguishable from paratyphoid types, and the suggestion of a connection between paratyphoid fever in man and the bacilli so frequently found in cases of swine fever is an interesting hypothesis, but the balance of evidence at present available seems to be distinctly opposed to any ætiological relationship. Most cases of paratyphoid fever in man are probably associated with specifically contaminated food, but the precise paths of infection cannot yet be said to have been determined.

Reports are contributed by Dr. Sidney Martin on the toxic products of streptococci. The first deals with the pathogenicity and toxins of the streptococcus (*S. faecalis*), so common in the intestinal contents. Injected intravenously into rabbits, this organism produces vegetative endocarditis of the mitral valve of the heart; this may have some bearing on the ætiology of acute rheumatism. The endotoxin on inoculation produces fall of temperature and great bodily weakness.

In the second the mode of growth and toxic products of the streptococcus (*S. pyogenes*) of suppuration are investigated.

The occurrence of "carrier" cases in relation with enteric fever is the subject of a memorandum by Dr. Theodore Thomson and Dr. Ledingham. The problem of "carrier" cases, *i.e.* individuals in whom the typhoid bacilli persist for long periods after an attack of enteric fever is a difficult and serious one. Treatment with vaccines and with sour milk have failed to eliminate the bacilli from cases on which they have been tried.

A very important report on the prevalence and sources of tubercle bacilli in cows' milk is contributed by Prof. Delépine. The conclusions are based on an examination of 5320 samples, and 474, or 8·9 per cent., proved to be tuberculous. Various administrative measures are discussed for the eradication of bovine tuberculosis. Details of experiments on the effect of the storage of glycerinated vaccine lymph at temperatures below the freezing point are contributed by Dr. Blaxall and Mr. Fremlin. Cold storage at $-5°$ C. for six months in no way diminished the activity of the lymph, and for two years only brought about a reduction in activity of about 2 per cent.

This necessarily brief survey of the contents of these volumes may, it is to be hoped, direct attention to the important researches carried out for the Local Government Board, and prevent the papers from being overlooked by those who are carrying out work in the same fields.

R. T. HEWLETT.

[1] Thirty-seventh and Thirty-eighth Annual Reports of the Local Government Board, 1907–8 and 1908–9. Supplements containing the Reports of the Medical Officer for 1907–8 and 1908–9.

SCIENTIFIC ACTIVITY IN NEW ZEALAND.

THE Philosophical Institute of Canterbury, New Zealand, is one of several very active scientific societies in Australasia. The annual report for the year 1909, presented to the annual meeting held last December, is a record of the continued success of the institute in its scientific undertakings. During the year the publication of the results of the expedition to the sub-Antarctic islands of New Zealand was steadily proceeded with under the editorship of Dr. C. Chilton. The reports upon the work will consist of two quarto volumes of about 400 pages each, and will be illustrated with numerous plates (some coloured), photographs, and text-figures; they will

accompanied by a large coloured map of the Antarctic and sub-Antarctic regions, showing the ocean depths as ascertained by recent expeditions.

Valuable scientific and economic work in botany has been carried on by Dr. Cockayne during the past two years. Although a great deal has been done in the way of establishing sanctuaries and national parks in order that the native fauna may be preserved for all time, the importance of placing on record their present ecological condition can hardly be overestimated. It is hoped that at some early date the Government may see its way to authorise Dr. Cockayne to proceed further with the botanical survey of the Dominion.

Largely owing to the representations of the institute, combined with those of the Otago Institute, the position of the memorial to the late Sir James Hector has been made satisfactory. Owing to the action of the Government in granting a generous subsidy, ample funds will be at the disposal of the committee for establishing a memorial that will be worthy of Sir James Hector's long and distinguished services to the cause of science in New Zealand. Observations in connection with the Arthur's Pass Tunnel were continued throughout the year. Temperature readings have been taken every ten chains and specimens collected. Early last year a committee was formed for the purpose of investigating systematically the artesian system of Christchurch and the neighbourhood. The committee has held several meetings, and has taken preliminary steps for ascertaining the extent, depth, and geological relations of the water-bearing strata, and for the examination of physical, chemical, and biological properties of the water obtained from them. Two papers by Dr. Farr and Mr. D. C. H. Florance, on the radium emanation contained in the artesian water and on the effect of the water as it comes direct from the well on trout and other fish, have already been laid before the institute.

A committee was appointed to consider the Animals' Protection Act, and to suggest amendments with the view of giving more effective protection to the native fauna of the Dominion. A conference was held with a similar committee appointed by the Canterbury Acclimatisation Society, and a number of recommendations were made which received the approval of the council. It is intended to submit the proposals to other institutes for their consideration, and if they meet with approval to bring the matter under the notice of members of Parliament and of the Minister for Internal Affairs. It is hoped later to send a party to the Chatham Islands for purposes of scientific investigation.

It is evident that the institute is not only encouraging interest in science by its monthly meetings, but is also actively engaged in promoting the progress of natural knowledge.

THE WORK OF LORD KELVIN IN TELEGRAPHY AND NAVIGATION.[1]

LORD KELVIN'S work was great and many-sided. We might compare it to the cathedral in some crowded mediæval city, where no place can be found commanding a general view. You approach by one narrow street or another, seeing from each only some portion of a particular face of the building. The Kelvin lecturer has, as it were, to select his view-point, conscious that he must concentrate his attention on what is, after all, but a small part of a gigantic whole. The lecturer might, for instance, take up the mathematical work of Kelvin in the theory of electrostatics, in the theory of magnetism, in the theory of elasticity, in hydrodynamics, in the wave theory of light; his contributions to thermodynamics, which included the establishment of an absolute scale of temperature and the enunciation of the principle of the dissipation of energy, his experimental work on the electrodynamic quality of metals, his speculations on the structure of matter, his views on the age of the earth, his share in fixing the electrical units; or, on the more practical side, his electrical measuring instruments, from the electrometers of the early days to the ampere balances and wattmeters which he designed when the need for such instruments became apparent with the growth of electrical engineering. Any one of these subjects, or others that might be named, would provide a more than ample text. To-night I have selected two portions of Lord Kelvin's work as the most suitable to bring before you, namely, his work in submarine telegraphy and in navigation. Both of these are practical matters which appeal to members of this institution. They illustrate well the bent of his genius as an engineer. In both of them he made inventions of first-rate importance—inventions which not only met an immediate requirement, but have stood the test of time; and an additional reason for the selection is the personal one that both in telegraphy and navigation it was my good fortune, as one of his young assistants, to see some of his inventions in the making.

His connection with telegraphy had begun long before, when he was only thirty years of age. It dates from 1854, and to appreciate rightly the part he began to play then I must ask you to go back as far as 1850, the year of the earliest submarine telegraph. It was in August, 1850, that a line consisting of a single copper wire, insulated by gutta-percha, wound on a great reel on the deck of a steam tug in Dover Harbour, was laid from Dover to Calais. There was no sheathing or protection of any sort; the line was what we should now call a bare core, and so light was it that lead sinkers were attached at every hundred yards to ensure its going to the bottom. In a few hours it was cut by the anchor of a fisherman, who took home a piece to show to his family as a curious new kind of seaweed; but during its brief life it gave the operators much food for thought. Accustomed only to the clear, sharp signals of land lines, they could make nothing of those got from the cable, and Mr. Willoughby Smith tells us how at each end of the line it was regretfully concluded that the operator at the other end must have been lunching, not wisely, but too well. This was the earliest experience of the effects of electrostatic induction in retarding the signals and altering their character. The cable is equivalent to an extended Leyden jar of large capacity, and at every application of the sending battery there is a gradual charging up, so that the signal current which arrives at the distant end does not at once reach its full strength; and, further, when the contact with the sending battery stops the current does not at once cease, but tails off slowly as the cable discharges the electricity it has accumulated. The current accordingly arrives in the character of a wave, slowly rising to a maximum value and then slowly subsiding each time a signal is sent.

In a short cable this causes little trouble; it only makes the process of signalling a little slower, but the instruments which serve on land lines may still be used. A successful Dover-Calais cable properly covered with a protecting sheath was laid in 1851, and was soon followed by other short lines. The general character of the electrostatic charge in a cable was explained by Faraday, and it was experimented on by Latimer Clark in a cable, 110 miles long, laid to connect England with Holland; but no one knew then in what manner the retardation of signals to which it gives rise depended on the electrical characteristics or how it would be affected in cables of different lengths or with different dimensions of core. It was in 1854 that Thomson's attention was directed to the subject by Stokes, following on a conversation at the British Association, and in this way began the connection with submarine telegraphy which was to prove of momentous import.

Thomson attacked the problem with characteristic ardour, and in less than twelve days he sent a complete solution to Stokes, which was published in fuller form in the Proceedings of the Royal Society for May, 1855. In this paper he points out that the effect of electrostatic induction is to make the flow of electricity in a cable correspond to the flow of heat in a solid conductor as investigated mathematically by Fourier. He formulates the equations and draws what is called the *curve of arrival*, the curve, namely, which shows in what manner the current gradually reaches its full value at the distant end of the cable, when contact with the battery is made at the sending end. He shows how the current falls away when the battery is removed and the cable is put to earth; and how, in cables of different lengths but of the same

[1] From the second Kelvin lecture, delivered at the Institution of Electrical Engineers on January 13, by Prof. J. A. Ewing, C.B., F.R.S.

dimensions of core, the time taken by the current to reach any particular fraction of the full value will vary as the square of the length.

This result of the theory was of fundamental importance. It was also, at the time, of particular interest, for the project was then beginning to be mooted of connecting England and America by wire. The only experience available as to speed of signalling was on short cables, and in passing from them to a line 2000 miles long the "law of squares," as it was called, seemed at first to give little prospect that signalling across the Atlantic could be accomplished at a speed that would be commercially practicable.

To lay the cable it was coiled on board two ships of war, the British battleship *Agamemnon* and the United States frigate *Niagara*. On August 5, 1857, the shore end was landed at Valencia, and the *Niagara* began to pay out, the intention being that her section should be laid first and the *Agamemnon* should continue the work after making a splice in mid-ocean; but the paying-out gear was very crude; the brake for maintaining a proper tension in the cable was difficult to regulate, and after 300 miles were laid there was a mishap at the brake and the cable parted in 2000 fathoms. The ships returned to Devonport, the cable was stored for the winter, new machinery was designed, and some 700 miles of fresh cable were manufactured against the next attempt, to be made in the following year.

Thomson had joined the expedition at the request of his brother directors, and was on board the *Agamemnon*. He came back full of ideas as to both the electrical and the mechanical sides of the great problem. On the mechanical side he had worked out, for the first time, the theory of the forces concerned in the laying and lifting of deep-sea cables; this was published almost immediately after his return. Let me give you a brief sketch of the results of this theory.

A cable paid out from a ship going at uniform speed does not hang as a catenary, but takes the form, as it sinks, of a straight line stretching at a uniform slope from the ship's wake to the point far in the rear at which it touches the bottom. This is because each part of the cable in sinking through the water attains almost immediately a constant velocity of descent against the resistance which the water opposes to its motion. Imagine a ball, heavier than water, to be dropped from a ship. It will, after sinking a foot or two, attain a practically uniform velocity, and keep that until it reaches the bottom. Imagine, now, a ship to drop a series of such balls, at regular intervals, while she steams ahead at a steady speed. At any instant the depth through which each ball has sunk will be proportional to the time which has passed since it was dropped, and therefore to the distance run by the ship, and hence a line joining the successive balls will be a line of uniform slope. The continuous cable behaves in this respect like the row of balls, but with this important difference. Each ball sinks vertically; it has no tendency to do anything else; but the cable tends, not only to sink, but to glide along the direction of its own length, just as a rope resting on an inclined plane tends to glide down it. A certain amount of such gliding is desirable, indeed necessary, for it secures that the cable will be laid with a sufficient percentage of slack to accommodate itself to any inequalities on the bottom, and to provide for the possibility of its being raised should that be required. It is the function of the paying-out brake to apply just so much retarding force as will allow the right amount of this gliding to take place, and not too much. As cables are actually laid, there may be 10 or 12 per cent. of slack, and this means a considerable velocity of gliding motion. In a cable of the type which was afterwards successfully laid across the Atlantic, the straight line had a slope of about 1 in $8\frac{1}{2}$—in other words, with a depth of two miles there were seventeen miles from the ship to the place where it touched bottom. On the gliding motion down this long slope the frictional resistance of the water is an important factor; it reduces very much the retarding force needed at the brake. If it were simply a question of holding the cable from gliding down the slope at all, the retarding force would be equal to the weight, in water, of a length of cable equal to the depth. In fact, however, it is about half that, the other half being accounted for by the frictional resistance the cable experiences in gliding down the slope.

In the early summer of 1858 the cable squadron was again ready to put to sea. New paying-out brakes had been devised. Thomson had succeeded, with much difficulty, in getting systematic tests of the conductivity established during the manufacture of the additional 700 miles. Most important of all, he had invented a new signalling and testing instrument which was to make Atlantic telegraphy commercially practicable. This was the mirror galvanometer, the first description of which is found in his patent of 1858.

We have no time to linger over the story of the cable of 1858. This time the two ships, after encountering a storm of great severity, in which the coiled cable suffered severe damage, met in mid ocean, spliced the cable, and began to pay out simultaneously, the *Agamemnon* steaming towards Ireland and the *Niagara* towards Newfoundland. The cable broke when only six miles were paid out. Again the ships met to make a fresh splice, and again the cable failed when some eighty miles had run out. A third attempt promised better, for some 200 miles were laid, when again the cable broke, this time at a place where it had been injured in the storm. The ships returned to Queenstown; Bright, Thomson, and the other leaders, disappointed but not discouraged, advised the Board to order a fresh attempt. Their advice was taken. The ships once more met at the mid-ocean *rendezvous*, and this time success crowned their efforts. On August 5 both ships completed their task, and the ends of the cable were brought to land.

Scarcely had the enthusiasm awakened by this great event begun to subside when it was apparent that all was not well. The Irish end of the cable had been handed over to Mr. Whitehouse, who attempted with little or no success to establish communication by means of his own signalling instruments. It was only when the galvanometer of Thomson was resorted to, with a simple Daniell battery to send the current, that messages were transmitted. The Board, dissatisfied with Whitehouse's action, directed Thomson to take complete charge. Various important messages passed, but the tests showed that the insulation of the cable had broken down; a bad fault developed, which had doubtless been intensified, if not produced, by the high-tension induction coils used by Whitehouse. The signals grew more and more feeble, and in a few weeks the cable altogether ceased to speak.

It never spoke again, and not until 1865 was the attempt made to lay a new Atlantic cable. By that time much had been accomplished. It was in the intervening years that the work of establishing standards for electrical measurement was undertaken by a committee of the British Association. The committee was appointed at the instance of Thomson, and he took a prominent part in its work. Besides this, the cable engineers were busy, and were gaining experience from lines laid in other places. Methods of systematic testing were devised; a type of cable was designed which was better adapted than before to bear the strain of laying, and especially the much severer strain of picking up, and material improvements were made in the paying-out machinery.

In 1865 the *Great Eastern* was available for laying the cable. Thomson, along with Cromwell Varley, went as a consulting expert on behalf of the company. Twelve hundred miles were successfully laid, and then a fault showed itself; picking up was begun, but in manœuvring the ship the cable parted in deep water. Attempts were made to recover it by grappling; three times it was hooked and brought part of the way to the surface, but the shackles used to couple up successive lengths of the grappling rope were too weak to stand the strain. Grapnel, rope, and cable were lost, and the ship returned with the task unfinished, but with everyone now full of confidence, not only that a sound cable could be laid, but that the lost cable could be found and lifted.

In 1866 the thing was done; an entirely new cable was laid with complete success, and then the *Great Eastern* with her consorts proceeded to the lost end of the cable of 1865, and began once more to fish in water more than 2000 fathoms deep. A fortnight passed before the watchers at Valencia saw any sign; then the spot of light began

to flicker, and presently the flickerings shaped themselves into letters and words. The cable had awakened to life. A few days more and it too was complete.

Throughout the operations Thomson was in the ship; Varley remained at Valencia. Thanks to their labours, and to those of Mr. Willoughby Smith, the contractors' electrician, the appliances for testing on board ship had been brought to a degree of perfection that left nothing to be desired. By this time it was generally recognised that the credit for Atlantic telegraphy, regarded as an electrical achievement, belonged to Thomson, though in his characteristic manner he would, when speaking of the subject, dwell on the parts played by others. Along with Mr. Canning, the engineer of the expedition, and Captain Anderson, who commanded the *Great Eastern*, he received the honour of knighthood.

For a time his mirror galvanometer remained the only instrument by which conversation could be carried on. He now proceeded to design a substitute for it which should give a record of the successive electric impulses instead of merely exhibiting them to the watchful eye of a skilled clerk. To secure greater power in the movement of the indicator he inverted the function of magnet and coil, making the coil the movable piece and the magnet the fixed piece. The coil was, therefore, made very light; the magnet, which being stationary might now be very heavy, was made exceedingly strong, and was arranged so that the coil lay in an intense field between its poles. The movement of the coil actuated a very light pointer, or rather pen, in the form of a siphon-shaped tube of fine drawn glass, from which ink was deposited on a running paper band. Here we find the earliest example of the moving coil type of galvanometer, often called the D'Arsonval type by those who do not recognise its real origin. It is a type now familiar in many practical instruments for the measurement of direct-current amperes and volts; but an important element in the invention is still to be named. It was essential that the glass pen should write without friction, and Thomson effected this by the happy device of electrifying the ink so that the ink and the paper attracted one another, with the result that the siphon was maintained in a constant state of rapid vibration, alternately advancing to the paper to deposit a minute drop of ink and then springing back, but all the time free to follow, without friction, the movements of the coil in obedience to the electric impulses arriving through the cable. Dynamically the siphon recorder has to satisfy the same conditions as those that determined the design of the mirror galvanometer. It draws on the moving strip of paper a curve of arrival for every one of the successive currents of which the signals are composed.

To this day the recorder remains in universal use as the standard instrument in submarine telegraphy. It has been simplified by the substitution of permanent field magnets for electromagnets, and by the use of an electromagnetic vibrator for the siphon instead of electrification —changes which were made in later years by Thomson himself.

It is time now to turn to Lord Kelvin's work in navigation. Taking the two oldest aids to navigation, the compass and the sounding-line, he revolutionised them both. Where most men would have thought there was nothing left for invention to do he found much. He has earned profound gratitude for appliances which add immeasurably to the security of all who go to sea. He has been called the best friend the sailor ever had; and it is said that a bluejacket was once overheard to remark, "I don't know who this Thomson may be, but every sailor ought to pray for him every night."

It was about 1873 that he began to study the compass seriously, partly because he had undertaken to write an article on it for *Good Words*, and partly because he had occasion to prepare, for the Royal Society, a biographical sketch of his friend Archibald Smith, containing an account of Smith's work on the theory of the perturbation of the compass caused by the magnetism of iron ships. Kelvin's first patent for an improved compass was taken out in 1876.

He found the compass full of serious defects. For one thing it was very unsteady—that is to say, it was liable to be set swinging through a large angle when the ship rolled. Sometimes an attempt was made to reduce this unsteadiness by introducing friction at the pivot, which, in a way, made matters worse by causing the compass to stick, pointing in a wrong direction. Under a mistaken idea of what would lead to steadiness, the card was made heavy and the needles long, and the long needles made it impossible to correct the compass properly for the magnetism of the ship. This was the most serious defect of all. In iron ships, and especially in ironclads, the compass is at the mercy of disturbing influences, which do much to mask the true directive force of the earth's magnetic field. To neutralise these is indispensable; the way to do it, as a matter of theory, had been pointed out, but it was only through the radical change in construction which we owe to Kelvin that it became possible to carry the process into effect.

He recognised that for this purpose the needles must be short. Further, that for steadiness what was wanted was a long period of horizontal oscillation—in other words, small magnetic moment relatively to the moment of inertia of the card; but, to keep the frictional error down, the weight of the card, including the needles, should be small. So he made the card as light as he could get it—a mere aluminium rim tied by silk threads to a small central boss, just as the rim of a bicycle wheel is tied to the nave by wire spokes, and from the silk-thread spokes he hung short pieces of magnetised knitting-needle to serve as the magnets. The result was that not only was the total weight very small, but it was nearly all in the rim, where it is most useful for giving moment of inertia and consequent slowness of period. Magnets and all, the card only weighs 180 grains for a 10-inch size, and yet its period of oscillation is much longer than that of the old standard compass, while its friction error is less.

Another admirable feature of Kelvin's invention was his method of keeping the compass always level and free from pendulum-like oscillation. He hung the bowl, as usual, from gimballs, but with knife-edges instead of the usual round spindles at the trunnions, and under the card he provided a chamber at the bottom of the bowl partly filled with castor-oil. You see this in the glass bowl now on the table. There is a glass partition to separate the place where the compass card stands from the lower part of the bowl, and in the lower part is the castor-oil. Its function is to damp out any oscillation of the bowl that may tend to be set up by the rolling or pitching of the ship, and it does so by dissipating the energy of such swings. At the same time the knife-edge gimballs leave the compass perfectly free to take up a true level.

Another feature is that the bowl and gimballs as a whole is hung from springs to withstand vibration caused by the action of the screw, or in warships by gun-fire.

Now as to the correction for the magnetism of the ship. Let me indicate very briefly the nature of that problem, and how it is solved.

An iron ship is a great magnet, or rather a great aggregate of many magnets. Her magnetism at any instant springs from two causes. First, there is the more or less permanent part, which she takes up first when she is built; it depends to a great extent on how her head lay while she was on the stocks. Then there is the induced part, which changes with every change of course—a transient effect due to the induction of the earth's magnetic field. Strictly speaking, the induced magnetism is not entirely transient, nor is the other by any means entirely permanent: but the ideal division into transient and permanent is a highly useful one provided we understand the limitation within which it is to be accepted. Now think of what happens when the ship is "swung," that is, turned so that she heads successively on all points. The permanent magnetism will cause an error of the compass which will be of the same nature as you would find if you placed a compass needle on a fixed pivot and disturbed it by turning a bar magnet slowly round a vertical axis. This error will reach a maximum twice in the revolution, once to one side and once to the other side—in other words, once in each semicircle. Hence it is called the semicircular error. The permanent magnetism of the ship has a vertical component, and this causes not only semicircular error, but also a heeling error, namely, a deflection of the compass when the ship inclines to either side.

By a combination of three sets of correcting magnets, two horizontal and one vertical, Kelvin obtained complete neutralisation of the disturbing effect of the ship's permanent magnetism, both as respects semicircular error in change of the ship's course and heeling error as she heels or rolls. From time to time, if the condition of perfect compensation is to be maintained, the position of these various correctors has to be altered, because of changes which take place in the so-called permanent magnetism of the ship. The navigator has always to be on the look-out for the gradual development of errors from this cause, however perfectly the first adjustment has been carried out.

We have next to consider the effects of induced magnetism. The most important of these arise from the fact that the ship is a long body of magnetisable material turning in a horizontal plane, and therefore subject to the inductive influence of the horizontal component of the earth's magnetic field. Think of what would happen if we were to take a pivoted compass needle and place it above or below a bar of soft iron, and slowly turn the bar round in a horizontal plane. We are to think of the bar as having no appreciable magnetic hysteresis, so that in every position it is the induced effect only with which we have to do. What will be the nature of the deviation? When the bar points north, and again when it points south, there is no deflection of the needle, for though the magnetism of the bar is then at its strongest, the field due to it is in the line with the undisturbed earth field; also when the bar points east or west there is no deflection, for the bar then takes up no magnetism; but between these points, namely, when the bar is pointing N.E., S.E., S.W., or N.W., the deflection is at its maximum. So in a ship's compass this error, due to the purely transient magnetism induced by the horizontal component of the earth's field, has its maximum on these four courses, once in each quadrant, and for that reason it is called the quadrantal error.

It is due, as we have seen, to the ship's being a long body, extending fore and aft, and it is corrected by balancing this excess of fore and aft iron by other iron, placed quite near the compass and on either side of it. The two balls which you see on the side of the Kelvin binnacle are the correctors for quadrantal error. They are adjusted, in the first place, by selecting a suitable size of ball, and then placing them nearer to or further from the compass until, on swinging the ship, the quadrantal error disappears. The possibility of correcting the quadrantal error in this way had been pointed out by Airy as early as 1840; but with the old form of compass card and needles it could not be done, because of the excessive length and large magnetic moment of the needles. To apply the method to a compass of the old pattern would have needed globes of impracticable size, not a few inches in diameter as these are, but weighing tons. Kelvin, with his short needles on a light card, made it possible to carry out the process, and so gave the world, for the first time, a compass that would point truly to the magnetic north, notwithstanding all the perturbations due to permanent and induced magnetism in the iron of the ship.

One more of these disturbing causes remains to be mentioned. The vertical component of the earth's field induces magnetism as well as the horizontal component, and gives rise to an additional error of two kinds, namely, a further semicircular error and a further heeling error. These are distinct from the semicircular error and heeling error due to permanent magnetism, and the right way to correct them is to fix a bar of soft iron in a vertical position[1] near the binnacle, so that the magnetism induced on it will act as a counter-balance. This is the Flinders bar, so called because its use was pointed out by Captain Flinders as early as 1801. It has generally to be fixed in front of the binnacle, and in Kelvin's compass it is made in several separate lengths of soft iron, which can be put together to make up a bar giving any necessary amount of correcting effect.

The main function of the Flinders bar is to correct the semicircular error due to induced vertical magnetism. So far as the heeling error is concerned it also helps, but in practice it is found convenient to correct a part of the heeling error due to induced magnetism by means of the same kind of permanent magnet correctors as I have already described in speaking of the heeling error due to permanent magnetism, namely, vertical magnet bars placed in a can in the binnacle directly under the centre of the compass card. The number and height of these bars has therefore to be altered from time to time, as the ship moves to regions where the vertical force is different. When the heeling error is fully corrected we escape one cause of the unsteadiness which a compass shows when a ship rolls, for we escape the magnetic cause of oscillation, namely, the alternate magnetic pull to port and starboard; but a purely dynamical cause of unsteadiness necessarily remains, arising from the fact that the point of suspension of a compass card must be placed some way from the centre of gravity to hold the card level against the dipping action of the earth's magnetic field. Consequently, every roll to either side applies a mechanical couple tending to set up oscillation, and if the period of the roll were the same, or nearly the same, as the period of oscillation of the card, the disturbance would become so great as to make steering by compass impossible. It was to secure steadiness in this sense that Kelvin strove to give his compass card a long period of oscillation, recognising that the right way to obtain steadiness was to make the period much longer than the period of the slowest rolling motion liable to occur in a ship, at the same time keeping the friction as small as possible. The problem of securing a steady, frictionless compass was a problem where, as in the invention of the mirror galvanometer, his genius for practical dynamics guided him to the right solution. In the case of the compass it was rendered difficult by the fact that other conditions, apparently antagonistic, had at the same time to be satisfied in order that the correction of magnetic errors might be completely carried out.

The evolution of the Kelvin compass, in its main features, took about five years; but a longer task lay before the inventor in overcoming the professional conservatism of sailors, the objections of the so-called practical man, active hostility in some quarters, and the passive resistance of official inertia. Gradually the compass came to be used in merchant vessels of the best appointed class. Enlightened navigators such as Captain Lecky, the author of the well-known "Wrinkles," became its enthusiastic advocates. Foreign admiralties took it up, and in our own service individual officers were quick to see its merits. Captain Fisher, now Admiral of the Fleet Lord Fisher, was warm in its praise after observing its behaviour in ships under his command, first in the *Northampton* in rough weather and afterwards in the *Inflexible* during the firing of heavy guns in the bombardment of Alexandria. That was in 1882; but it was not until November, 1889, that the superintendent of the Compass Department of the Admiralty was in a position to inform Lord Kelvin that his 10-inch compass was to be adopted as the standard compass for the Navy. This was twelve years after the date of his patent, and more than eleven years after he had laid the invention formally before the First Lord. The way of the inventor, like that of the transgressor, may still be hard, but I trust it is not so hard now as it was then. One does not care to dwell on the spectacle of a Kelvin spending his strength in disheartening effort as the sea beats against a cliff. It is painful to read the correspondence and discussions of these weary years. One does it with increased admiration of the infinite patience which at last secured to us the benefits of his practical genius.

The use of the Kelvin compass may now be said to be universal, except that in the Navy a modified form, due to Captain Chetwynd, with a card immersed in liquid, is taking the place of the Kelvin dry card in the newer ships as being steadier still under gun-fire. The system of correction remains substantially unchanged, and the compass continues to embody the same mechanical features as formed the basis of Kelvin's invention.

In the navigational sounding machine we have another invention of first-rate importance, second only to the compass in practical value to sailors, and remarkable for its extreme simplicity. It was his cable-laying experience that first led Kelvin to take an interest in deep-sea sounding. The process, as then carried out, was a laborious one. The line was a rope an inch and a half in circumference,

[1] That is to say, vertical when the ship is on even keel or perpendicular to the deck.

and though it carried a very heavy sinker, the resistance to its motion through the water was so great that it took a long time to reach the bottom. For the same reason the ship had to be stopped while the line ran out, and, except in shallow water, while it was being heaved in. Many hands were needed, and much time was spent in making a cast. Hence it came about that the operation of sounding, beyond the use of the hand-lead in quite shallow water, was but little resorted to as an aid to navigation, notwithstanding the importance of the indications it could give in such cases as when a ship was approaching land in a fog or in circumstances which made the exact position uncertain, when the depth might be anything up to, say, one or two hundred fathoms.

I have spoken already of Thomson's study of the forces acting on a cable during its submersion. Applying these principles to the sounding-line, he recognised that to make the line slip down quickly it should have the smallest possible and the smoothest possible surface, and this led him to use a single wire of steel—the steel of high tensile strength used in pianofortes. In 1872 he demonstrated the practicability of using wire by taking a sounding and finding bottom at 2700 fathoms in the Bay of Biscay with a 30-lb. sinker and a single wire of No. 22 gauge. He soon devised a suitable drum and winding-in wheel for deep-sea use, and from this was developed later a compact form of navigational sounding machine by which flying soundings are taken without stopping the ship.

In a flying sounding the wire streams out behind, taking an oblique course to the bottom, and the length of wire that runs out is greatly in excess of the depth. To read the depth directly, Thomson invented several forms of depth gauge, the simplest of which is a long narrow glass tube, closed at the top, and coated inside with chromate of silver or some other chemical which is discoloured by the action of sea-water. This tube is put in a protecting case, which is attached near the sinker, and as it descends the increased pressure forces the sea-water up into it, compressing the air, and indicating the depth by the height to which the chemical lining is discoloured. Accordingly, the depth is read off by laying the tube against a scale, when the line is again drawn on board.

This machine has become a standard navigational appliance. The length of wire in common use is 300 fathoms. A strand of seven fine steel wires, which gives greater flexibility, is now substituted for the single wire. It runs out under a regulated tension, supplied by a rope brake, which retards the rotation of the drum on which the wire is wound. When the sinker touches bottom the tension is at once seen to slacken, or rather felt to slacken by a sailor who keeps a little rod of wood lightly pressed against the wire while it runs out; the drum is stopped, and the wire is slowly wound in again by hand, or in the latest naval type by electric motor. Lord Kelvin's final improvements in the machine were made only a year or so before his death; they were, in fact, his last serious inventive work. They include a large horizontal dial for reading the number of fathoms of wire out, and with this it is often practicable to tell the depth very closely without resorting to a depth gauge at all; for in the modern machine the action is so uniform that, at any given speed of ship, a definite relation holds between the depth and the length of wire out, and by finding this relation once for all a table can be prepared by which the speed is known, and so when the length of wire out is observed the depth may be at once inferred. This system is now in regular use in the Navy. A pair of the Kelvin machines stand on the bridge; the wire runs out along a boom at either side and over an ingeniously designed pulley or fair-lead; whenever soundings are wanted, they can be taken systematically and in quick succession while the ship proceeds at undiminished speed, and the depth is called out for the information of the navigating officer almost as soon as the wire has stopped running out. Alike in the Navy and the merchant service, there is no difficulty in making it a matter of routine to keep the sounding machines going incessantly when near shore or within, say, a hundred fathoms in thick weather.

(Dr. Ewing then went on to speak of Lord Kelvin's advocacy of the Sumner or "position-line" method of working out sights at sea, and his tables for facilitating Sumner's method; also his harmonic analysis of the tides and his tide-predicting machine.)

In attempting this account of the work of Kelvin in telegraphy and navigation, I am embarrassed by its volume and its range. The time has proved far too short for a fitting notice of discoveries and inventions so various, so fundamental, so far-reaching in their practical effects. Yet we have dealt only with a very small part of the whole achievement of a man not less remarkable for sustained industry than for outstanding originality—a man incessant in action and in thought—of whom it may be truly said that there is no department of physics on which he has not left an abiding impress.

I have said nothing to-night of the lofty flights of scientific imagination, which are, perhaps, his highest title to fame; but I have said enough to show that Kelvin was no mere philosopher with head in the clouds. He was quick to recognise a real need, quick also to see how the need should be met. He found material for invention in the most commonplace appliances, because his mental habit was in everything to seek for the how and the why and to ask himself in what way the thing might be done better. He had an infinite faculty of taking pains, of adhering to a purpose until he secured its full accomplishment, of going on from improvement to improvement in pursuit of the more perfect result, and with all this a courage and hopefulness that no opposition could damp, that never accepted defeat.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. E. W. Hobson, F.R.S., fellow, tutor, and lecturer in mathematics at Christ's College, has been elected Sadlerian professor of pure mathematics. Dr. Hobson was senior wrangler in 1878, and has been mathematical lecturer in the University since 1884, a lecturer in Christ's College since 1879, and for the last few years Stokes lecturer. His earlier published work related principally to spherical harmonics, Bessel's functions, and other allied functions, together with the cognate subject of the theory of the potential. On these subjects he published a memoir in the Philosophical Transactions of the Royal Society, two memoirs in the Cambridge Philosophical Transactions, and a series of papers in the Proceedings of the London Mathematical Society. About the year 1900 Dr. Hobson began to publish a series of papers dealing with the theory of aggregates, that of functions of real variables, the theories of G. Cantor, and the fundamental principles of mathematical analysis; and in 1907 his treatise on the theory of functions of a real variable, and on Fourier's series, was published by the University Press. Since the appearance of this book he has, during the last two years, published several papers, in which he has given a general convergence theorem, and applied it to questions connected with the representation of functions by means of series of Sturm-Liouville functions, Legendre's and Bessel's functions, and to the elucidation and extension of the theory of Hamilton's fluctuating functions. He has also quite recently published papers dealing with Lebesgue's new theory of integration, in relation to the fundamental processes of the integral calculus.

LONDON.—The first annual report of the Military Education Committee on the work of the university contingent of the Officers' Training Corps, which was presented to the Senate on February 23, has been issued. The contingent, which was formed under the authority of a War Office letter dated January 7, 1909, numbered 24 officers and 783 enrolled cadets at the end of the year. Three units are included, an engineer unit of one company, an infantry unit of a battalion of six companies, and a medical unit of three sections of a field ambulance. An application has been submitted to the War Office for permission to organise Artillery and Army Service Corps units, and to augment the medical unit. University College has the largest number of cadets (160), King's College coming second with 132; and the medical schools, especially Guy's (67) and Middlesex (64), are well represented. The report contains much statistical information throwing light on the

ages and educational antecedents of London students. As regards the ages of cadets, the largest groups (159 and 151 respectively) fall in the age limits nineteen to twenty and twenty to twenty-one. Of the 783 cadets, 127 were educated abroad—48 in India, 48 in other British dominions and colonies, and 31 in foreign countries. The educational results achieved in the contingent appear to be satisfactory, 232 cadets having already entered for Certificate A and 3 for Certificate B granted by the War Office for military subjects. The first camp was held at Salisbury Plain in August, and the first inspection by Major-General Sir F. W. Stopford, which was held during camp, produced a highly satisfactory report.

IT is announced in *Science* that a department of experimental breeding has been established in the college of agriculture of the University of Wisconsin. Dr. L. J. Cole, of the Sheffield Scientific School at Yale, has been appointed an associate professor of experimental breeding. Dr. Cole will take up his new work shortly, and will conduct investigations in the subject of experimental breeding, with special reference to the laws of heredity and improvement of animal life.

SIR GEORGE GREENHILL contributes some impressions of a visit to Berlin and its educational establishments to the *Engineer* for February 25. The chief object of his visit was to accept an invitation to examine the Militärtechnische Akademie, an establishment devoted to the instruction of officers in the science and manufacture required in modern warfare. Sir George seems to have been deeply impressed with this splendid and efficient institution, which is such as we have not in this country. Sixty officers are under instruction for a course of four years, more complete than is required now for a degree in honours at Cambridge, and their zeal and interest is said to be enthusiastic; it is considered bad form not to give the very best for the glory of the Fatherland. Of special interest was the modern ballistic laboratory established in the last four or five years, under the direction of Prof. C. Cranz. This includes lecture and experimental rooms filled with the most modern apparatus, and alongside a bomb-proof range of 60 metres. Sir George Greenhill seems to have taken delight in showing Prof. Cranz how to apply the six-point contact principle as required for a rifle rest, using for the purposes of demonstration some nails and a broomstick with broom, as a rifle was not for the moment at hand. The principle was given very clearly about 1867 in Thomson and Tait's "Natural Philosophy," but, as Sir George truly remarks, is too scientific for the official expert to grasp.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 24.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir William **Abney**: colour-blindness and the trichromatic theory of colour vision.—W. **Cramer** and H. **Pringle**: Contributions to the bio-chemistry of growth. The total nitrogen metabolism of rats bearing malignant new growths. The nitrogenous metabolism was determined in rats before and after transplantation with a rapidly growing spindle-celled sarcoma. The results show that less nitrogen is necessary to build up a certain weight of tumour tissue than is necessary to build up an equal weight of somatic tissue of the host. No evidence could be obtained that the tumour cells had a higher affinity for nutritive material than the growing cells of the host, or that they secreted substances having a toxic action on the nitrogenous metabolism of the host. The conclusion was arrived at that the cells of the new growth derived the nitrogenous material necessary for the building up of new tissue by a sparing of the protein metabolism, so that a smaller amount was utilised as a source of energy and a larger amount for the building up of new tissue.—W. **Cramer** and H. **Pringle**: Contributions to the bio-chemistry of growth. The distribution of nitrogenous substances in tumour and somatic tissues. Estimations were carried out of the total nitrogen content of rapidly growing transplanted tumours (carcinoma and sarcoma), and of the tissues of the animals bearing these tumours. The results, which confirm those arrived at by observations on the nitrogen metabolism of tumour-bearing animals, show that the nitrogen percentage of rapidly growing tumours is smaller than that of the tissues of the host or that of the tissues of normal animals. This diminution in the nitrogen percentage was found to be due to the fact that, weight for weight, the cancerous tissue contains only about three-fourths of the amount of protein substances present in the tissues of the host. In other words, with the same amount of protein a bigger mass of tumour tissue than of host tissue can be built up. The simpler abiuret nitrogenous products of cell metabolism, however, are present in slightly greater amount in the cancerous tissue. It is pointed out that these results have a bearing on the mode of growth of cancerous tissue. Since the tissue of a neoplasm can be built up with less protein than the same weight of host tissue, the former must grow more rapidly than the latter in circumstances where both are using up nitrogenous material for mere growth at the same rate.—A. **Harden** and W. J. **Young**: The alcoholic ferment of yeast-juice. Part v., the function of phosphates in alcoholic fermentation. The two following equations were previously proposed by the authors to represent the course of alcoholic fermentation by yeast-juice:—

(1) $2C_6H_{12}O_6 + 2PO_4HR_2 = 2CO_2 + 2C_2H_6O + 2H_2O + C_6H_{10}O_4(PO_4R_2)_2$.

(2) $C_6H_{10}O_4(PO_4R_2)_2 + 2H_2O = C_6H_{12}O_6 + 2PO_4HR_2$.

These were founded on (*a*) the determination of the amount of carbon dioxide and alcohol produced by the addition of a known amount of phosphate in presence of excess of sugar; (*b*) the production of a hexosephosphate of the composition $C_6H_{10}O_4(PO_4R_2)_2$; (*c*) the occurrence of an enzymic hydrolysis of this substance with production of free phosphate. In order to obtain further experimental justification for this view, several additional determinations have been made, and these form the subject of the present communication. The results which have been obtained are as follows:—(1) When glucose or fructose is added to yeast-juice in presence of excess of phosphate, a period of accelerated fermentation occurs, during which the added sugar undergoes the reaction (1) quoted above, one molecule of carbon dioxide being evolved for each molecule of sugar added. (2) When the available phosphate of a mixture of ferment, coferment, and sugar is greatly reduced, the total fermentation produced becomes very small. The addition of a small amount of a phosphate to such a mixture produces a relatively large increase in the total fermentation, even after allowing for the amount of carbon dioxide equivalent to the phosphate added. (3) A hexosephosphate when digested with yeast-juice is hydrolysed by an enzyme (hexosephosphatase) with production of free phosphate, and a sugar, which is capable of being fermented by yeast. As the result of this hydrolytic action the hexosephosphates when treated with yeast-juice or zymin are finally converted into carbon dioxide, alcohol, and free phosphate. In the light of these results it becomes necessary, in discussing the chemical changes which the molecule of sugar may undergo in the process of fermentation, to take into consideration the fact that two molecules of sugar are involved in the reaction.

Zoological Society, February 15.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—R. E. **Turner**: Additions to our knowledge of the fossorial wasps of Australia. Many new species were described, belonging chiefly to the families Thynnidæ and Ceropalidæ. The Thynnidæ had been collected chiefly by Mr. H. M. Giles in South-western Australia, and many interesting notes had been contributed by him on their habits. The sexual differences were extreme, and hitherto few Western Australian species had been correctly paired. The females were wingless, and the mouth-parts extremely minute, so that only liquid food could be taken, and this was usually disgorged by the male and placed in the mouth of the female. Mr. Giles had observed several cases of cross-pairing, in which the male was carrying the female of a different species; there could be no doubt as to the accuracy of this observation, though it was possible that the male claspers might be used for carrying the female when coupling did not take place. The geographical distribution

of the genus Anthobosca (fam. Scoliidæ), now almost entirely confined to the Southern Hemisphere, was also discussed.—H. H. **Druce**: Descriptions of new Lycænidæ and Hesperiidæ from tropical South Africa. The paper contained an account of the numerous new forms collected by Mr. G. L. Bates on the Ja River, Cameroons, and by Herr Landbeck in the Upper Kasi district of the Congo.—G. L. **Boulenger**: Certain subcutaneous fat-bodies in toads of the genus Bufo. In *Bufo viridis*, of which the author had examined fresh material, these fat-bodies were very well developed, and on reflecting the skin from the ventral surface, one noticed a pair of gland-like fatty structures at the junction of the hind limbs with the trunk. They were present in both sexes, and varied considerably in size and colour in different individuals, but were quite constant in position.

Linnean Society, February 17.—Dr. D. H. Scott, F.R.S., president, in the chair, succeeded by Mr. H. W. Monckton, treasurer and vice-president.—W. T. **Saxton**: Recent investigations upon the anatomy of the genera Widdringtonia, Endl., and Callitris, Vent. Evidence is brought forward to show (1) that Widdringtonia and Callitris do not conform to the "Cupressineæ" type; (2) that Widdringtonia cannot be merged in the genus Callitris, but must rank as a distinct genus. Callitrineæ is suggested as a tribal name to include these two genera (possibly also Actinostrobus and Tetraclinis). Both morphological and anatomical differences are pointed out between Callitris and Widdringtonia, which seem more than sufficient to warrant the retention of Widdringtonia as a separate genus.—G. **Massee**: Evolution of parasitism in fungi. To understand clearly the evolution of parasitism it is important to grasp a fundamental point in the evolution of fungi generally. The most primitive forms were aquatic, and reproduced by zoospores, which necessitated the presence of water to secure their dispersion. As the fungi gradually took possession of dry land, a second asexual or conidia form of reproduction, suitable for dispersion by wind, &c., was gradually evolved. This supplementary conidial condition is always the form that has assumed a parasitic condition, the older sexual phase remaining as a saprophyte, and developing when the host is exhausted. Parasitism is mainly the outcome of opportunity, and the fact that fungi present all stages of parasitism, and that a saprophytic fungus can be educated to become a parasite, proves that parasitism is an acquired habit. Incipient or imperfectly evolved parasites promptly kill the host, and consequently curtail the period of their own existence, as *Pythium De Baryanum*. A higher stage of parasitism is reached by many of the rusts and smuts, *Ustilago avenae*, &c., where the host is attacked as a seedling, and is stimulated to an unusual condition of growth throughout its normal period of growth. More advanced parasites show a tendency to arrest the production of spores and conidia, and to perpetuate themselves by perennial mycelium located in some perennial vegetative portion of the host (root, tubers, &c.) or in the seed. In the most highly evolved parasites reproductive bodies are entirely arrested, and the parasite is perpetuated by hibernating mycelium only.—T. B. **Fletcher**: The Orneodidæ and Pterophoridæ of the Seychelles Expedition.—Dr. G. **Enderlein**: Die von Herrn Hugh Scott auf den Seychellen gesammelten Embiidinen, Coniopterygiden, und Hemerobiiden.—Dr. N. F. **Holmgren**: Die Termiten der Seychellen-Region.—L. A. **Borradaile**: The land and amphibious Decapoda of Aldabra.

Royal Anthropological Institute, February 22.—Sir Richard Martin, vice-president, in the chair.—Miss M. E. **Durham**: Notes on High Albania. High Albania is the only spot in Europe in which the tribal system exists intact. The tribes occupy the mountain land which forms the north-west corner of Turkey in Europe. They are exogamous, but male blood only counts. Each tribe is ruled by a council of elders, by ancient laws handed down by oral tradition, which are strictly enforced. Roughly, the tribes may be divided into three groups, one of which tells a tale of origin from Bosnia, the second of partial origin from Rashia, and the third, which declares that it has "been there all the time." The tale of origin from Bosnia is confirmed by the fact that the same tattoo patterns used by these tribes are used in certain districts of Bosnia. They consist of various arrangements of the cross, the sun, and the moon. Among other very ancient customs, the Levirate is still practised, even by many of the Roman Catholic tribes. Blood vengeance is extremely prevalent throughout both Christian and Moslem tribes. Its rules are complicated. It is undertaken rather to cleanse the honour of the slayer than to inflict punishment on the slain. Up country the houses are all stone kulas (towers), built for defence, and having no windows, but only loop-holes for rifles. Communal families of as many as forty members live together in one room, ruled by the house lord, who has often power of life and death over his subjects. Marriage is always by purchase, save for an occasional forcible capture. Children are betrothed in infancy. Thirteen to fifteen is a common age for a girl's marriage, and fifteen to eighteen for a boy. Hospitality is the universal law of the mountain. The tribesman, if he receives a traveller at all, gives him of his best.

PARIS.

Academy of Sciences, February 21.—M. Émile Picard in the chair.—G. **Humbert**: The minima of the classes of binary and positive quadratic forms.—Armand **Gautier**: The differential characters of waters arising from springs of superficial or meteoric origin and of waters of central or igneous origin. In opposition to the accepted views of Daubrée, the author regards many mineral waters as virgin springs, not arising from infiltrated water, but issuing for the first time from the earth. Somewhat similar views have been advanced by Suess. These virgin waters are characterised by their issuing from eruptive faults or in relation with metallic lodes, by being independent of the seasons and meteorological phenomena, by the constancy of their composition and temperature throughout the year, and by the presence of certain elements such as fluorine, boron, arsenic, iodine, &c., and by the absence of the carbonates of the alkaline earths.—Gabriel **Kœnigs**: The conjugated curves in the most general relative movement of two solid bodies.—H. C. **Saint-René**: A solution of a problem of vision at a distance.—Percival **Lowell**: New canals on the planet Mars. Two large canals east of Syrtis Major were observed at the Flagstaff Observatory on September 30, and reasons are given for supposing that these canals are really new on Mars. They have the character of the other canals—a uniform line of geometrical appearance.—Charles **Nordmann**: The intrinsic brightness of the sun. The effective temperature of the solar photosphere is estimated at 6450° C. absolute. The intrinsic brightness of the sun is calculated to be 319,000 decimal candles per square centimetre.—M. **Coggia**: Observations of the comet 1910*a*, made at the Observatory of Marseilles with the Eichens equatorial of 26-cm. aperture. Positions are given for February 4, 5, 7, 8, 9, 10, and 11.—W. **Stekloff**: A general theorem of existence of fundamental functions corresponding to a linear differential equation of the second order.—D. **Pompéiu**: The singularities of uniform analytical functions.—Jean **Chazy**: Differential equations the general integral of which possesses an essentially mobile break.—G. **Cotty**: The transformation of Abelian functions.—Marcel **Brillouin**: Concerning functions determined by their value on a part of the boundary and that of their differential coefficient normal to the remainder of the boundary.—A. C. **Vournasos**: The reaction of nascent hydrogen in the dry state. By heating sodium formate, with or without the addition of sodium hydroxide, hydrogen is evolved. If phosphorus, sulphur, or arsenic is added to this mixture, and the whole heated to about 400° C., the corresponding hydrogen compounds of these substances are obtained. With sulphur, the pure dry sulphuretted hydrogen prepared in this way is suitable for use in analysis.—H. **Baubigny**: The separation and purification of the dithionates produced in the decomposition of silver sulphite or its double salts.—H. **Gaudechon**: The bromine derivatives of dimercurammonium.—V. **Auger**: The alkaline mangani-manganates. These compounds arise from the action of permanganates upon moist caustic soda, slowly in the cold, rapidly on warming, with loss of oxygen. The sodium salt has the composition

$$Mn_2O_3.5Na_2O.8H_2O.$$

—Léo **Vignon**: Textiles and insoluble colouring matters.—H. **Copaux**: The inequality of the properties of the two forms (right and left) of potassium silicotungstate, and, in

general, of crystals possessing rotatory power. The salt isolated by Wyrouboff was dextrorotatory only. The author has accidentally obtained a lævorotatory variety, and has been able to show that these two forms differ greatly in stability, the lævo variety passing over completely into the dextro form on re-crystallising from water. The two species differ considerably in their solubility.—J. **Wolff**: The action of the alkaline dibasic phosphates on tyrosinase. A reply to some remarks of M. Agulhon. Experiments are cited in detail showing that the action of the enzyme is much assisted by the presence of sodium phosphate, although at the commencement the phosphate retards the reaction.—M. **Billon-Daguerre**: The sterilisation of liquids by radiations of very short wave-length. The invisible region of the spectrum, with wave-lengths between 1030 and 1100 Ångström units, is the seat of radiations possessing a chemical action about twenty-five times greater than the ultra-violet rays produced by mercury vapour lamps. The apparatus described utilises these very short radiations; details are given of its sterilising activity, and a domestic installation is figured possessing advantages economically over the mercury vapour lamp steriliser.—Paul **Hallez**: The protection encystment of *Prostoma lumbricoideum*.—H. **Vincent**: The active immunisation of man against typhoid fever. A new antityphoid vaccine.—F. **Kerforne**: The pre-Hercynian movements of the Breton massif.—M. de Montessus **de Ballore**: The barograph considered as a recording seismoscope. Records on barographs have frequently been found to show disturbances corresponding to earthquake shocks. From the examination of four years' barograms taken at Santiago, it is concluded that the barograph cannot be regarded as a useful seismoscope.—F. **Dienert**: The estimation of fluorescent substances in the control of the sterilisation of water.

DIARY OF SOCIETIES.

THURSDAY, March 3.

Royal Society, at 4.30.—The Depression of Freezing Point in very Dilute Aqueous Solutions: T. G. Bedford.—Sturm-Liouville Series of Normal Functions in the Theory of Integral Equations: J. Mercer.—The Solubility of Xenon, Krypton, Argon, Neon, and Helium in Water: A. von Antropoff.—Measurements of the Absolute Indices of Refraction in Strained Glass: Dr. L. N. G. Filon.

Royal Institution, at 3.—Illumination, Natural and Artificial (Experimentally Illustrated): Prof. S. P. Thompson, F.R.S.

Röntgen Society, at 8.15.—Dental X-ray Technique: C. A. Clark.

Linnean Society, at 8.—Our British Nesting Terns: W. Bickerton.

FRIDAY, March 4.

Royal Institution, at 9.—Magnetic Storms: Dr. C. Chree, F.R.S.

Institution of Civil Engineers, at 8.—Reinforced Concrete as applied to Retaining-walls, Reservoirs, and Dams: A. J. Hart.

Geologists' Association, at 8.—On a Fuller's Earth Section at Combe Hay, near Bath: L. Richardson.—Some Notes on the Superficial Geology and Physical Features of Epping Forest: S. Hazzledine Warren.

SATURDAY, March 5.

Royal Institution, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

Essex Field Club (at the Essex Museum, Stratford, Essex), at 6.—Some Notes on the Cricket-bat Willow (*Salix alba*, var. *coerulea*) in Essex: Miller Christy.—Report on the Lichens of Epping Forest (first paper), together with some General Remarks on the Group: R. Paulson and P. G. Thompson.

MONDAY, March 7.

Aristotelian Society, at 8.—The Reality of Individua: Miss H. D. Oakeley.

Royal Geographical Society, at 8.30.—Land and People in the Kasai Basin of the Congo: E. Torday.

Royal Society of Arts, at 8.—Lead Work: L. Weaver.

Society of Chemical Industry, at 8.—The Rational Analysis of Clays: W. C. Hancock.—On the Application of Pressure Gas to Furnace Use: A. W. Onslow.—A New Gas Sampling Tube: G. Nevill Huntly.—The Complete Analysis of Leather, and a Common Mistake in the Determination of the Degree of Tannage: Dr. J. Gordon Parker and M. Paul.—The Spontaneous Decomposition of Blasting Gelatine: J. B. Henderson.

Society of Engineers, at 7.30.—Sewage Disposal Ideals: W. C. Easdale.

Victoria Institute, at 4.30.—Assur and Nineveh: Dr. T. G. Pinches.

TUESDAY, March 8.

Royal Institution, at 3.—The Emotions and their Expression: Prof. F. W. Mott, F.R.S.

Royal Anthropological Institute, at 8.15.—Exhibition of the Gibraltar Skull, with Lantern Demonstration of Certain Features Characteristic of Palæolithic Man: Dr. A. Keith.

Institution of Civil Engineers, at 8.—Birmingham Sewage-disposal Works: J. D. Watson.—Salisbury Drainage: W. J. E. Binnie.

WEDNESDAY, March 9.

Geological Society, at 8.—The Carboniferous Succession in Gower (Glamorganshire): E. E. L. Dixon and A. Vaughan.

Royal Society of Arts, at 8.—The Public Trustee and his Work: C. J. Stewart.

THURSDAY, March 10.

Royal Society, at 4.30.—*Probable Papers*: The Causes of the Absorption of Oxygen by the Lungs (Preliminary Communication): C. Gordon Douglas and Dr. J. S. Haldane, F.R.S.—The Action of Nicotine and other Pyridine Bases upon Muscle: Dr. V. H. Veley, F.R.S., and Dr. A. D. Waller, F.R.S.—The Extinction of Sound in a Viscous Atmosphere by Small Obstacles of Cylindrical and Spherical Form: C. J. T. Sewell.—The Ionisation of Various Gases by the Rays of Actinium: Dr. R. D. Kleeman.

Mathematical Society, at 5.30.—Forms for the Remainder in the Euler-Maclaurin Sum-formula: W. F. Sheppard.—The Scattering of Light by a Large Conducting Sphere: J. W. Nicholson.

Institution of Electrical Engineers, at 8.—Short Circuiting of Large Electric Generators and the Resulting Forces on Armature Windings; The Design of Turbo Field Magnets for A. C. Generators with Special Reference to Large Units at High Speeds: Miles Walker.

Royal Society of Arts, at 4.30.—Indian State Forestry: Saint-Hill Eardley-Wilmot.

FRIDAY, March 11.

Royal Institution, at 9.—Ionisation of Gases and Chemical Change: Dr. H. Brereton Baker, F.R.S.

Physical Society, at 8.—On Coherers: Dr. W. H. Eccles.—Earth-air Electric Currents: Dr. G. C. Simpson.—An Automatic Toepler Pump designed to Collect the Gas from the Apparatus being Exhausted: Dr. B. D. Steele.

Malacological Society, at 8.—Pleistocene, Holocene, and Recent Non-marine Mollusca from Mallorca. Marine Shells from Alcudia, Mallorca: Rev. R. Ashington Bullen.—Classification of the Gastropoda: R. J. Lechmere Guppy.—On the Occurrence in England of *Valvata macrostoma*, Steen: A. S. Kennard and A. W. Stelfox.—Description of a New Species of Helicodonta from Spain: G. K. Gude.

SATURDAY, March 12.

Royal Institution, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

CONTENTS.

THURSDAY, MARCH 10, 1910.

THE SURVIVAL OF MAN.

Survival of Man. A Study in Unrecognised Human Faculty. By Sir Oliver Lodge, F.R.S. Pp. xi+357. (London: Methuen and Co., 1909.) Price 7*s*. 6*d*. net.

THIS is a book that will attract great attention, and deservedly so. There is a well-known saying recommending men, especially judges, to give their conclusions, but never their reasons. Possibly this is wise advice in the realm of law, but it is a hopeless attitude of mind in the regions of philosophy, where the reasons are of the essence of the transaction, and the conclusions may be merely the incorrect deduction of a mind as imperfect as our own. When, therefore, a man of the standing of Sir Oliver Lodge consents, if we may use the expression, to do his thinking aloud, to lay himself open indifferently to the scoffs of the convinced unbeliever and the wistful commiseration of the unconvinced would-be believer; when he allows us to see the process by which he himself has become persuaded of the most fundamental doctrine of life, the whole community owes him a very great debt of gratitude.

To most people the question of the survival of human personality is the greatest problem of life; a positive answer one way or another would affect the actions and aspirations of mankind more than any other possible consideration or discovery. It is because of the momentous character of the subject, because of the effect that a positive assurance would have on the majority of mankind, that it has never been possible for a person who believed himself by any means to have obtained this assurance to keep the grounds of his conviction to himself. From the point of view of the present band of investigators, of which Sir Oliver Lodge is a distinguished member, having regard to the intensely intimate nature of their experiences, one may well doubt how far it has been expedient to take the general public, as yet, into the confidence of the small group of fellow-workers. Science has this great advantage over other kindred branches of intellectual activity, such as literature and art:—the general public does not profess to understand its workings; nay, a large section of the public prides itself on its inability to understand the methods of science. By this means, men of science often escape the premature notoriety which is destructive alike to patient investigation and to the inspiration of wayward genius. Especially in the case of the experiments with which Sir Oliver Lodge deals in the last chapters of his book, we may wonder how far it has been entirely discreet at present to open the discussion to the general public.

But the very magnitude of the issues at stake makes it difficult for any earnest mind to keep the results, tentative as they appear, the property of a small circle. It is not easy to imagine circumstances which would justify the creation, even for a short period, of a "corner" in truth. It is therefore in accordance with the best traditions of English science that the results of these investigations, as soon as they seem to be of value to the outside world, should be at its disposal.

The book before us does not profess to give an account, or even a summary, of all the work which has now been accomplished on the subjects of telepathy, clairvoyance, hypnotism, &c. As we have already said, it contains the story of the way in which, throughout the last quarter of a century, Sir Oliver Lodge has been led to believe, as the result of carefully planned experiments, if not that evidence of the survival of man—or, more correctly, of certain men—has already been collected, at any rate that there is no reason why it should not be collected. We do not think that anyone unfamiliar with the recent publications of the Society for Psychical Research will feel that he has proved his point. The nature of the evidence prevents any single or any several incidents in themselves from carrying conviction, and will always prevent it. It is the cumulative effect, added to a personal realisation of the nature of the evidence, that must be relied on. But even the proceedings of the Society for Psychical Research are published in an abbreviated form, and Sir Oliver only gives a few quotations and references to this mass of already selected facts.

At present the chief interest of the subject centres round the theory of cross correspondences, emanating chiefly from the so-called controls that are manifested in certain well-known and much discussed automatic scripts, and claim to represent the surviving personalities of Myers, Hodgson, and others. Here again the general reader cannot possibly realise how much is conveyed by the revelation of personality, in characteristic phraseology, in appropriate knowledge, in intellectual equipment. A voice in the dark may bring absolute assurance to anyone familiar with that voice of the corporal presence of a certain being, while it is meaningless or passes unheard to a person who is unfamiliar with it. Similarly, indications of known personalities, examples of typical intellectual activities continuing after earthly existence has ceased, may accumulate to such intensity that no hypothesis is so simple or so effective as that which involves the acceptance of the belief in their manifest survival; and after all, it is the essential nature of a satisfactory hypothesis, which in due course may develop into one of the so-called laws of nature, that it should offer the simplest and most effective explanation of certain ascertained facts. We do not imagine that the present book will suffice to convince anyone who is without other assurance; but we can well understand that those who have had the experience of Sir Oliver Lodge should feel that the hypothesis of the survival of man cannot long remain in the outer court of the enshrined truths of natural philosophy.

AN AMERICAN HIGH-SCHOOL BOOK ON AGRICULTURE.

Elements of Agriculture. By Prof. G. F. Warren. Pp. xxiv+434. (New York: The Macmillan Co., 1909.) Price 5*s*. net.

"THE purpose of the present book," says Dr. Bailey in an introductory note, "is to make the teaching of agriculture in the existing high schools comparable in extent and thoroughness with the teaching of physics, mathematics, history and literature."

"The interest in the teaching of agriculture," continues the author, "is but a part of a much larger question—the movement for teaching by means of things that have come within the student's experience. The underlying reason why such teaching is desirable is because it brings the schools in touch with the home life—the daily life of the community. A large part of our teaching has had no relation whatever to our daily life."

Thus the author justifies the introduction of agriculture into a high school. The subject is undeniably interesting to elder scholars whether they propose going in for farming or not, but the author goes further, and maintains that it is of real educational value and can be presented in such a way as to train the student to think. Few people would dispute these views, but we have had to wait until now for a little handbook in which they are logically carried out.

The book is not, of course, intended for elementary schools. The author presupposes some knowledge of chemistry and botany, and makes no attempt to gloss over difficulties. It is doubtful whether a scholar could study the subject profitably until he is some sixteen years of age. The author begins with the principles underlying the improvements of plants and animals by crossing and by selection. Mendel's law and its applications are dealt with at length, and mutation forms are also discussed. In illustration of the improvement effected it is shown that the percentage of sugar in the sugar beet has increased from 8 to 18 per cent. or more, whilst maize, cotton and other crops have undergone no less change. The propagation of plants forms the subject of the next chapter. Root stocks, tubers, cuttings, grafting, budding, are described in some well-illustrated pages, and then we pass to the consideration of seeds and germination tests. The student is thus led to the study of the food required by the young plant; he finds that at first it comes from the seed, afterwards from the air and the soil. A brief sketch is given of the processes going on within the plant, the manufacture of plant food, and so on. The soil is next considered; it is shown to consist of small rock particles, soil water, soil air, decaying organic matter, and living organisms, all of which are dealt with in some detail. As usual in American books great stress is laid on the importance of soil water. The reason is very obvious; two-fifths of the United States is too dry to raise good crops without irrigation, and the Government is building large reservoirs for storing irrigation water. Further, dry farming is practised there to a greater extent than anywhere else as yet. On the other hand, on the Atlantic coast the water supply is sometimes too great and a good deal of the land requires draining.

The author discusses at some length the methods for maintaining the fertility of the land. Soils have become productive by lying for ages in prairie or forest condition whilst organic matter has gradually accumulated until some sort of equilibrium is attained. With the advent of man the equilibrium is upset, the prairie is broken up, grain is grown for many years, and the wastage, which in any case would be considerable, is increased by the common habit of burning the straw of the crops. Only in old, long-settled countries is the full value of farmyard manure appreciated. "Very few farmers in any part of America," says the author, "have yet learned to handle manure without losing one-half of its value." Among the causes of decreased productivity, erosion by wind or water is considered the worst, but it may be prevented by keeping the soil in crop as much as possible. Exhaustion of the humus supply is, however, regarded as the fundamental cause for the decrease in crop yields. Methods of restoring the fertility of the soil by means of manures, green crops, and animal excretions are described. Then follow some interesting chapters on the various crops—maize, cotton, wheat, timber and so on—their economic importance, their methods of cultivation, and the pests to which they are liable. Finally, there is a discussion on the feeding of animals.

The treatment quite justifies the author's claim that agriculture is a suitable subject for training the mind. The book is conceived in a scientific spirit, and executed with great skill. It is just the book for the young agricultural student, or, indeed, for any young student. All the illustrations are, naturally, American, but the teacher on this side will find it very useful in making up his course, although he will probably wish that an equally good book written from an English standpoint was available.

ELECTRONIC THEORY OF MATTER.

La Radioattività. A. Battelli, A. Occhialini, S. Chella. Pp. xxxii+xii+438. *Atti della fondazione scientifica Cagnola dalla sua istituzione in Poi.* Vol. xxii. (Milano, 1909.)

TWO of the most noticeable features of Continental publications of a scientific character are, first, the number written in a semi-scientific manner for popular consumption, and, secondly, the variety dealing with special branches of chemistry or physics in a manner capable of being readily followed by men of science interested chiefly in other branches of these subjects. The present volume is an excellent example of the second class. The first part consists of reports on essays concerned with different subjects, and is followed by the work of Prof. Battelli and his coadjutors, to whom a prize of 2500 lire and a medal were awarded for their memoir on "The Discovery of Radio-activity and its Influence on Physical and Chemical Theory."

In this book of 438 pages the chief facts of radioactivity are set forth in a most interesting and lucid style, and their bearing on chemical affinity, the electronic theory of matter, and the periodic law is discussed in a manner equally able. The standard books on conduction in gases and radio-activity usually contain too much detail, except for experts in these branches of physics; the present authors do not profess to give a full account of the facts, but only of those that are necessary to show the development of recent theory. Great praise is due, not only for the clearness with which these facts are dealt, but also for the skilful choice of material from a large mass

of detail. No book of a similar scope is published in English, and it may be recommended without hesitation to students desiring a succinct statement of facts and their bearing on modern theories of matter. Having said so much, we may perhaps be permitted to point out various small blemishes.

Chapter i. gives an account, in forty pages, of the chief results obtained by the study of gaseous conduction. The usual revolving paddle-wheel is given as an instance of the mechanical effects produced by kathode rays, but it has been shown by Stark that this is due to the heating and not to the momentum of the rays. The properties of positive rays are given in one short paragraph; as they are of outstanding interest at the present time, it might have been expected that something more recent than W. Wien's original experiments would be mentioned.

On p. 61 the extinguishing action of radium on a long spark is ascribed to the conductivity produced, but, as Peck and the present writer have shown, a far greater conductivity may be produced by Röntgen rays without producing extinction.

Chapter iii. should be especially useful to chemists, dealing as it does with the instruments used and the methods of standardising them; Wilson's tilted electroscope might have been included.

On p. 127 a method is given of demonstrating the positive charge carried by α rays; actually the indications of the electroscope would be the same if the rays were uncharged; all the experiment shows is that the β rays are charged negatively. The proper demonstration is given later.

The deduction of the transformation constants from the decay curves is exceptionally well done, as is also the question of electromagnetic mass. In connection with the latter, Sir J. J. Thomson has given reasons for thinking that the number of electrons in an atom is small; these reasons should have been mentioned in the discussion of atomic architecture.

Chapter xi. gives an account of conduction in metals according to the electronic theory. A difficulty, not mentioned here, is the fact that on this theory, according to Thomson, the energy required to raise, say, a gram of silver one degree is about ten times that shown by experiment.

Finally, in a book of such a scope we should expect to find some reference to the work of Campbell and others on the radio-activity of the commoner elements.

R. S. W.

POPULAR ASTRONOMY.

(1) *Astronomical Curiosities, Facts and Fallacies.* By J. Ellard Gore. Pp. x+370. (London: Chatto and Windus, 1909.)

(2) *Curiosities of the Sky. A Popular Presentation of the Great Riddles and Mysteries of Astronomy.* By Garrett P. Serviss. Pp. xvi+268. (New York and London: Harper and Brothers, 1909.) Price 6s. net.

IT is admittedly unwise to judge a book by its cover. It would seem to be quite unsafe to judge it by its title. Two books, by a quaint coincidence very alike in their titles, demand notice together. Notwithstanding their initial similarity, they each appeal to a distinctly different class of readers.

(1) To anyone with an already developed interest in general astronomy the collection of "curious facts, fallacies and paradoxes" contained in Mr. Gore's book will doubtless prove interesting and suggestive. It does not pretend to tell a connected story. It certainly does not. Neither does it present a fairly complete picture of the astronomy of to-day. Elements of the subject are not dealt with, and facts loom larger than theories. It is essentially a book of "extras."

The information given, which the author believes will not be found in popular works on astronomy, has apparently been gleaned mostly, though of course not exclusively, from English and American publications of recent years. Each fact is presented in all its individuality with a local habitation and a name. It is in effect an excellent astronomical scrap-book, with the scraps arranged into chapters and with references scrupulously and copiously given.

The sun and the planets are each dealt with in sequence. The first nine pages contain statements about the sun's "stellar magnitude," temperature, possible length of life and source of heat. Remarks as to the discovery of argon and neon in the sun's chromosphere (which is probably an erroneous identification), about various observations of D_3 and concerning the discovery of sun-spots, all find a place in this first chapter. From this some rough idea of the character of the work may be gathered. Considering the great and growing importance of solar physics, this chapter might have been enlarged with profit. To allot no more space to the sun than to each of the planets in turn is surely an unbalanced treatment. The succeeding chapters devoted to comets, to double, binary and variable stars, and to nebulæ, will be found closely packed with information. Following these comes a rather large section of 73 pages concerned with mythological and modern details about the constellations and their included stars. The temperament that found a dictionary the most readable of books would have gloried in these chapters. That the general reader will struggle through them it is difficult to believe.

It is not to be supposed because the work suffers from its limitations that it is not valuable. As a well-written compendium of facts it satisfies a distinct want. Where such want exists it can be recommended. The book is well printed and bound. It is fully indexed, and is light and pleasant to handle.

(2) "Curiosities of the Sky" is a book of quite another type. Here the selecting hand of the artist has been at work. "Facts" are included only when they help the presentation of the subject. The series of chapter-essays into which the publication is divided are excellently written and generally well informed. Astronomical "coal sacks," under the title of "The Windows of Absolute Night," star clusters, star streams and stellar migrations form the subject-matter of the first fifty pages. An interesting chapter on the passing of the constellations follows. Here the

author, by effective description and diagrams, shows the asterisms the Great Bear and the Hyades to be but transient phenomena, and the exquisite Corona Borealis but a passing show. New stars, nebulæ, and the sun itself next provide material for the author's pen. It will be noticed that the chapters follow, in some sort, an evolutionary sequence. In spite of the temptations of the subject, extravagant and loose statements are rare, though a few have been met in reading. To state that "except for the interference of the moon, we should probably never have known that there is any more of the sun than our eyes ordinarily see" is forgetting that the spectroscope was at least a possibility whether eclipses had occurred or not. Similarly forgetful is the remark that "no instrument now in the possession of astronomers could assure us" that there are planets revolving round other stars than the sun. The statement respecting Mercury that its "average temperature is more than six and a half times that prevailing on the earth" is quite inexcusable. Some attempt at precision in a matter quite capable of being stated clearly is surely worth while.

In spite of such blemishes the book, as a popular exposition of certain phases of modern astronomy, ranks high. Hypotheses respecting the zodiacal light mystery are clearly set forth, while auroræ, comets, and meteorites are suggestively treated. Chapters dealing with the moon, Mars, and the riddle of the asteroids bring an interesting work to a conclusion. Some thirty full-page half-tone reproductions of photographs are inserted, most of them being well chosen and excellently reproduced.

The printing and binding are satisfactory, but the inset illustrations are not securely fastened and are liable to come out. T. F. C.

WONDER BOOKS OF SCIENCE.

(1) *The Wonder Book of Magnetism.* By Dr. E. J. Houston. Pp. x+325.

(2) *The Wonder Book of Light.* By Dr. E. J. Houston. Pp. xii+349. (London: W. and R. Chambers, Ltd., 1909.) Price 3*s.* 6*d.* each.

DR. HOUSTON has attempted, in these two volumes, to deal with the two specified sections of physics in such a way as to render them interesting to young people. In order to attain this end he has had recourse to the somewhat novel method of frequently using fairy stories as illustrations. Dr. Houston has had considerable experience in teaching the young, and, therefore, probably knows far better than the writer the kind of treatment of the subjects most likely to appeal to them. But the general impression obtained by an adult reader is that the illustrations are, to say the least, far-fetched, and that it is surprising if children, while sufficiently young to take delight in the fairy stories, can also appreciate the serious parts of the books. We hardly expect to find in the same volume the story of "The Blowing Servant of Fortunio" and the description of Zeeman effect as "the duplication or triplication of spectrum lines when the glowing vapour is subjected to a powerful magnetic field." Nor is it usual to associate "The Magic Wand of Prince Percinet" with a treatment of the colours of thin films and the colour of skylight.

The parts of the books which actually deal with physics are excellent. The language is generally simple, and the discussion is much more clear and exact than is usually the case in elementary treatises. Stripped of the fairy stories, both volumes could be read with much profit by grown persons desirous of enlightenment on magnetism and light. The probability is, however, that such seekers would be warned off by the juvenile complexion of the work, and thus miss the abundance of useful information contained therein. One further criticism is that some of the diagrams, of which each volume contains a considerable number, are badly reproduced. This, however, is not surprising when the low price of the books is taken into account.

With regard to the contents of the separate volumes, that on magnetism contains, besides the usual description of the properties of magnets, an interesting chapter on the history of the discovery of magnetism, and another on the possible causes of terrestrial magnetism. The auroral light and its bearing on the latter is also fully described. The reciprocal relations between magnetism and electricity are clearly stated, and a chapter is devoted to the electromagnetic theory of light. As examples of the less serious side of the volume may be mentioned the chapters entitled "Have Magnets Healing Powers?" and "Magnetism and Magic."

Among the special subjects treated in the volume on light, attention may be directed to the chapter entitled "The Light Mill," in which Crookes's radiometer is described, and to those on optical illusions and the effects of persistence of vision. Others are phosphorescence and fluorescence, X-rays and radioactivity, photography, soap-bubble colours, opalescence and polarised light. These are all dealt with quite briefly, but, nevertheless, in a lucid and interesting manner.

In conclusion, one may congratulate the juvenile readers upon having these two books so carefully written on their behalf, and express the hope that some time the author may see his way to publish the volumes in a slightly revised form suitable for older children.

OUR BOOK SHELF.

The Periodic Law. By A. E. Garrett. International Scientific Series. Pp. vi+294. (London: Kegan Paul and Co., 1909.) Price 5*s.*

THIS book may be viewed in two aspects—as a body of information and as a narrative. As a body of information it is very comprehensive. In no other work dealing with the periodic law, so far as the present writer knows, has the statistical information been set forth so fully and discussed in such detail. The author deserves all the credit due to a laborious compiler, and it may seem ungrateful to make any qualification in acknowledging such services. Little seems to have been omitted in the way of

facts. The more recent work on tellurium is not adequately dealt with, nor is there a reference to the calculations of Strutt in reference to Prout's hypothesis, but there is little occasion for complaint on this head and much to acknowledge. There is a good deal of historical detail as well, and on all these grounds Mr. Garrett's book will no doubt find its way to chemical libraries and be valued as a book of reference.

When, however, we come to view the book as a narrative, it suffers from its wealth of detail, and does not seem to be in line with the well-known series to which it belongs. This is perhaps a matter which concerns the editor more than the reviewer; but the periodic law can furnish a capital narrative of a type which made the International Scientific Series famous a generation ago, a type which is preserved in the recent welcome additions. From this point of view Mr. Garrett's book is not only impaired by its abundance of statistics, but by carelessness of style. The English is very far from smooth, and such sentences as "Many things, no doubt, in some measure helped to bring about the state of affairs which proved to be the natural forerunners of such a climax" are very uncomfortable to an arm-chair reader. A. S.

Leitfaden der Pflanzenkunde für höhere Lehranstalten. By Dr. K. Smalian. Pp. 326. In five parts. (Leipzig: G. Freytag; Vienna: F. Tempsky, 1909.) Price, part i., 1 mark; part ii., 1.25 marks; part iii., 1.30 marks; part iv., 2.25 marks; part v., 2 marks.

IN these days, when many authors attempt to compress as much information as possible into their text-books, it is unusual to find an introduction to morphological and systematic botany spread over five annual courses. It should, however, be noted that each course is a short one, sufficient for one term's work, or possibly for two.

The first volume contains a series of descriptions of individual plants, arranged, according to their flowering periods, from March to July, and, so far as possible, in a sequence of complexity. A further series is given in the second course, as well as a few comparative summaries of related plants by which family limitations are introduced. The third and fourth parts are similar, except that the family synopses are more numerous, and eventually plant-associations are explained. In the fifth volume the author describes types of the Coniferæ, pteridophytes, and lower cryptogams, including the bacteria and myxomycetes; he also presents an account of the more common plants of economic value, and a brief epitome of plant geography. In addition, summaries are provided at the end of each volume, partly to recapitulate main facts, and partly for drawing comparisons. In this way the Linnean system is expounded in the third and fourth volumes. Numerous artistic coloured plates add considerably to the value of the book, especially where they depict the plants in natural habitats and associations.

The production of the book, the subject-matter, and the arrangement all merit strong commendation. The fundamental training in morphology by means of practical observation leads naturally to classification and ecology of plants. But two general objections suggest themselves; first, that there is need for more physiology, and, secondly, that in five annual courses a schoolboy could be taught considerably more botany than is contained in these volumes; as regards the latter, there is no reason why after the first summer session the remaining parts should not be taken more expeditiously. It may also be suggested that a good account of plant distribution instead of so many cryptogamic types would have been much more suitable for the last volume.

Die Bienen Afrikas nach dem Stande unserer heutigen Kenntnisse. By Dr. H. Friese. Edited by Dr. Leonhard Schulze.) Pp. 85–475, and plates. (Jena: Gustav Fischer, 1909.) Price 36 marks.

THIS important work is primarily based on the collections made by Dr. Schulze, who obtained forty-two species in Western South Africa as against forty-seven recorded by Bingham for the Transvaal and Natal. But Dr. Friese has taken the opportunity to include the Ethiopian region south of Senegal and Abyssinia. Abyssinia is only included in respect of Xylocopa, and Madagascar is excluded, as it has a separate fauna already discussed by Saussure in Grandidier's work.

A prominent feature of Prof. Friese's work is the series of maps of Africa showing the distribution of various species of bees throughout Africa; while other maps show the distribution of various important genera of African bees throughout the world. This is followed by a short bibliography, and even on the same page the technical portion of the work is commenced by a list of the thirteen African species of Prosopis. This is followed by a table of five South African species after Alfken and descriptions of the whole thirteen species, in the original language (Latin, German, or English) in which they were published. The remaining genera and species are similarly treated, a list of all the species being first given, and sometimes (but not always) a more or less complete table of the species, before they are described. On p. 124 an elaborate figure is given of the mouth-organs of *Polyglossa capensis*, n.sp. The book concludes with a list of thirty-five genera and 783 species of African bees (including the subspecies of *Apis mellifica*), many of which are described as new in the present volume, and an alphabetical index. The two coloured plates of bees, &c., are excellent. W. F. K.

Logic of Nature: a Synthesis of Thought. By Arthur Silva White. Pp. 58. (Privately printed by T. and A. Constable.)

THIS is an attempt to "outline a system of thought by which unity of world-conception may be predicated." It is a large order—vulgarly speaking—and a pamphlet of fifty-eight pages cannot be expected to give very clear notions of the author's views. Neither can a short review give a very clear notion of the pamphlet, which, for the rest, is very tough reading even for those who have spent much time and thought on the subject. The following "heads," however, will suggest the general drift.

There are four spheres or planes in the macrocosm: lithosphere, hydrosphere, atmosphere, and ethersphere, which last-named is "the psychosphere of mind"—"the energy of thought." Matter is the vehicle of energy. Intelligence is at the root of things; immanent Deity must be postulated. "*Nature is the thinking-process of the God-head*"—a striking and suggestive phrase.

The author quotes appositely from Sir J. J. Thomson, Sir J. Larmor, Snyder, and others on the physical side; and from Spinoza, Mill, Spencer, and Hamilton on the side of logic or metaphysics. His conclusion is of course idealistic. "The ultimate reality of the sum of things cannot—so far as man is concerned—have existential import except in terms of thought; and therefore thought itself is the ultimate reality" (p. 36).

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Dr. H. J. Hansen and the Copenhagen Museum of Zoology.

On behalf of the zoologists who have signed the accompanying letter to Dr. H. J. Hansen, of Copenhagen, I have been asked to send a copy to you with the request that you will be good enough to publish it in Nature.

W. T. Calman.

1 Mount Park Crescent, Ealing, W., March 7.

March, 1910.

To Dr. H. J. Hansen,
The University Museum of Zoology,
Copenhagen.

Dear Dr. Hansen,

We, being some of those among the zoologists of Great Britain who know and value your zoological work, have heard with regret that there is a chance of your leaving the Museum of Zoology in Copenhagen. We hope that this is not the case; and we more especially hope and trust that you will let no circumstances turn you aside from your important zoological investigations.

The Museum of Steenstrup, of Lütken, and of Schiödte is honoured by us all; we know and honour many of the fellow-workers and successors of those great naturalists; and we consider that among so many distinguished names your own is by no means the least distinguished.

To the researches that you have carried on for many years, partly by yourself, partly together with your learned compatriot, Sörensen, we owe the best part of our knowledge of several important orders and families of Arthropods; you figure in our text-books as the leading authority on such difficult groups as the Palpigradi, the Pauropoda, the Cryptostemmatidæ, the Hemimeridæ, and the Choniostomatidæ; and this partial list of your works is in itself a proof that you have always laboured just where there were real gaps and imperfections in the common stock of zoological knowledge.

Your Monograph on the Choniostomatidæ we would refer to in particular as a masterpiece of delicate dissection and exquisite illustration; while in one and all of your publications we recognise the keenest morphological insight, and an uncommon grasp of the essential principles of classification.

With our best wishes for your prosperity, we beg you to receive from us this tribute to your powers and this testimony of our personal regard.

Very faithfully yours,

(*Signed*) A. Alcock, E. J. Allen, Ernest E. Austen, F. A. Bather, G. A. Boulenger, Gilbert C. Bourne, W. T. Calman, G. H. Carpenter, Wm. Eagle Clarke, C. Clifford Dobell, J. Cossar Ewart, F. W. Gamble, J. Stanley Gardiner, W. A. Herdman, Sydney J. Hickson, E. W. L. Holt, E. Ray Lankester, E. W. MacBride, W. C. McIntosh, P. Chalmers Mitchell, A. M. Norman, R. I. Pocock, Edward B. Poulton, R. F. Scharff, Adam Sedgwick, A. E. Shipley, Thomas R. R. Stebbing, J. Arthur Thomson, D'Arcy W. Thompson, Chas. O. Waterhouse.

Colour Blindness.

When reading the late case of Mr. John Trattles and his colour-blindness, and when considering the discussion on the value of the tests for colour-blindness in its practical bearing for seamen and engine-drivers, it occurred to me that there was a very simple means of enabling red-blind and green-blind persons to distinguish red lights from green lights, and both of these from white lights, without their having to recognise the colours at all. I tested a colour-blind person here first with red glass and next with green glass placed in front of a cycle lamp, and he could not distinguish between the red and the green; but with the aid of my device he could distinguish the red light from the green light without fail, though he could not see them as distinct colours. The means of effecting this is quite simple. I gave him suitable pieces of red and of green glass. I told him to look at the white light first through the red glass and then through the green glass; result, he could see the white light through either glass, though he could not distinguish the colours, but when he could see the light clearly through each separately of his pieces of glass he knew the light was not green or red, but white.

I then made the lamp shine through a piece of red glass, and told the man I was testing to look at it first through his bit of red glass and then through his bit of green glass; result, he could see the light of the lamp through his bit of red glass, but could see no light through his bit of green glass, and so he knew the light of the lamp must be red, though he did not know its colour. Next I made the light shine through a piece of green glass, and when my man looked at it through his green glass he could see the light clearly, but when he looked at it through his piece of red glass he could not see it at all, or only very, very dimly, if the green glass of the lamp was a pale green and let some white through with the green, but in either case he could say with certainty the light was green and not red or white, and this without recognising the colours as colours.

The practical application of the above facts is simple, and can be effected in a variety of manners and inexpensively. For example, a sort of double eye-glass could be made holding a suitable piece of red and of green glass and with a small handle, and made of a size easily to fit in the pocket, or, for use at sea, it might take the form of a simple night-glass with a small slider carrying the coloured glasses at the eye-piece end. Anyone can try experiments in this matter with the aid of a bicycle lamp and its green and red light on either side, and suitable pieces of red and green glass to look through.

Summary.—When the lamplight can be seen clearly through both the red glass and the green glass separately: conclusion, the light is white.

When the lamplight is seen through the red glass and not through the green glass: conclusion, the light is red.

When the lamplight is seen clearly through the green and not through the red, or only very, very dimly: conclusion, the light is green.

It is not a case of distinguishing by colour recognised, but by whether the light can or cannot be seen in each case.

I offer this suggestion in case it may be of any service, and unpatented, for the free use of all who like to use it.

Stonyhurst. H. M.

The Meaning of Ionisation.

The columns of Nature are doubtless not the proper place in which to conduct correspondence classes in elementary science, but when Prof. Armstrong asks a simple question surely mere courtesy demands that he should receive a straightforward answer, such as Prof. Walker and "A. S." have not given him.

I imagine that nobody will quarrel with the following definitions :—

Ions are particles supposed to be present in some media such that, when the medium is placed in an electric field, the particles have a finite average velocity relative to the medium along the direction of the field.

"Ionisation" is used in two senses :—(1) it is used to denote the number of ions present in unit volume of the medium; (2) it is used to denote the process by which the ions are produced. Since several such processes are known, the use of the word ionisation does not connote any special hypothesis as to the mechanism by which the ions are produced. N. R. C.

A Rare Crustacean.

Yesterday my assistant, Mr. G. Pyman, found several *Cheirocephalus diaphanus* swimming in a flooded ditch on Eton Wick Common. The sunlight shining on the beautiful green bodies of the males made a very striking effect. We were able to catch about twenty specimens of both sexes. I had never seen this phyllopod alive before, and, so far as I know, it has never been recorded previously from this district. The females, of brownish-purple colour, all have

full egg-cases attached to their abdomens. I put several individuals into different aquaria, and was much annoyed to find that they fell victims to various enemies during the night. A Dytiscus beetle, the presence of which had been forgotten, accounted for four, and four more were apparently devoured by insignificant fresh-water snails. Those, however, that were placed in a tank by themselves are alive and well, and feed on the green algæ supplied to them. The males are about $1\frac{1}{2}$ inches long, the females rather smaller.

When the river comes down in flood experience shows that it is time to be on the look-out for zoological curiosities. Perhaps Apus itself may reappear once more now that Cheirocephalus has shown the way!

Eton, March 5. M. D. HILL.

The Formation of Large Drops of Liquid.

THE following experiment, based on the temperature-density relations between aniline and water, serves to illustrate to an audience the various shapes through which a drop passes in the course of its formation. A glass beaker, about 9 inches in height and $4\frac{1}{2}$ inches diameter, is filled to about 7 inches with distilled water, and about 80 c.c. of aniline are added. The beaker is then placed on a burner, and the temperature raised until the aniline floats to the surface of the water. On spreading out at the surface the aniline is cooled, thereby becoming denser than the water beneath. A large drop, 1 inch or more in diameter, then detaches itself from the mass at the surface, the formation being so slow that the altering shapes of the drop, the drawing out of the neck of liquid, and the thinning of the neck in two places may easily be observed. The large, detached drop falls to the bottom of the beaker, and is there re-heated, thereby again becoming lighter than the water, and rising to the surface, when a second drop is formed. By maintaining the temperature about 80° the formation of drops continues indefinitely in the manner described. The slightly pink colour assumed by the aniline enables the experiment to be seen clearly from a considerable distance, and the many beautiful shapes assumed by the drops lend an added interest to this simple method of demonstrating their formation. CHAS. R. DARLING.

City and Guilds Technical College, Finsbury.

The Fertilising Influence of Sunlight.

THE letters of Mr. and Mrs. Howard and of Dr. E. J. Russell in recent issues of NATURE point to the conclusion that the partial sterilisation of the soil improves its fertility. In connection with this subject, I would like to record that the effect of heating the soil has been observed here for some years. It has been the practice to collect all the refuse of the place that cannot be rotted, such as hedge cuttings, tree prunings, &c. These are placed on a vacant space in the kitchen garden and a fire made of them in winter. The fire is generally a large one, burning fiercely all day, and the larger branches keeping it going all night.

In the following summer the site of the fire is well marked. The rows of vegetables where they pass over it are more than a half stronger than at other parts, though they do not keep that proportion to the end of the season. The increased growth seems to be due to the heating of the soil, and not to the large amount of wood ashes left by the fire, as these are either lifted and used as a top dressing for borders where the spade cannot be used, or are spread over the vegetable ground, the site of the fire being generally left quite bare of ashes.

Ardenlea, Falkirk, March 8. JOHN AITKEN.

MOLES AND MOLEHILLS.

LIKE that of other common animals, the complete life-story of the mole has yet to be written, exceedingly little being really known. The difficulties of observing the habits of a subterranean dweller of a most retiring disposition are patent but not altogether insuperable, and the wonder is that field naturalists have been content to read and take for granted the information handed down for the last century without any attempt to confirm it.

During the winter months one cannot help noticing in the open fields here and there a mole-heap conspicuously larger than the rest. This is a male mole's winter habitation, but at present we do not know whether he lives alone or with his wife, or if the female ever constructs these "fortresses," as they are called. Probably he lives alone, and probably females make "fortresses" slightly more simple in construction and smaller in size than those of the males. If we take a spade and carefully slice away the top of a fortress, we shall find several hollow tunnels or runs, which may be opened up and followed to the base of the "fortress," whence they lead away into the field. Slicing further under these into the "fortress," and

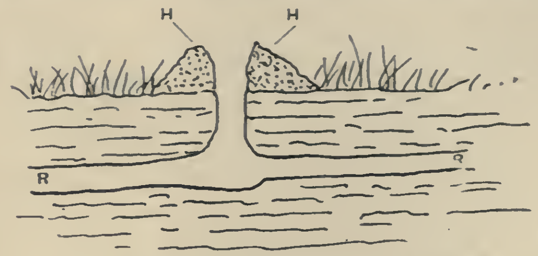


FIG. 1.—First stage of the fortress—sectional view. R R, Mole's run below the surface; H H, heap of ejected earth.

just below the ground-level, we come upon a large circular cavity filled with a bundle of grass or dead leaves; this is the mole's nest in which he sleeps. If he has lately quitted it the interior will be quite warm to the hand; the mole himself, however, will never be caught in the nest. When the nest is removed and the cavity examined, it will be found about a foot in diameter and worn smooth by the mole wriggling about as he wraps his nest round him, for that is his method of arranging himself within it. Two or more tunnels will be found leading away from the nest-cavity into the field. One of these is particularly noteworthy, as it is found in nearly every fortress;

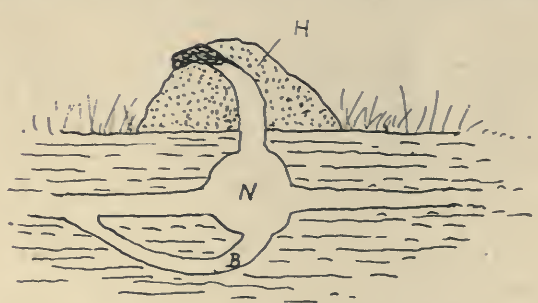


FIG. 2.—Second stage of the fortress—sectional view. N, Nest-cavity; B, bolt-run; H, heap of ejected earth.

this exit leads from the bottom of the nest perpendicularly downward for about a foot, then, turning upwards, it joins another run. Its origin and use are uncertain, but it is usually regarded as a sort of sally port, and is known as the "bolt-run."

It is extremely unlikely that the mole deliberately selects the site of his fortress, as he is practically blind; probably he sets to work whenever the impulse seizes him, and proceeds in the following manner. He commences to enlarge a nest-cavity, ejecting the earth which he has loosened with his powerful claws out of a hole in the roof; this he does with the top of his head in little jerks. The quiet observer may see a sausage-shaped mass of earth issue from below

with four or five sudden jerks, then, after one or two minutes' interval, when the mole is collecting more loose earth, another sausage will appear as before, and so on until the work is complete. After the nest-cavity comes the excavation of the bolt-run, and finally, to make all safe and waterproof, the mole piles up a mass of earth, often amounting to a large barrow-load, by means of tunnels around the base of the existing heap. These tunnels sometimes break into one another and sometimes into the nest-cavity, and so cause a labyrinth which has given rise to much erroneous speculation in the past.

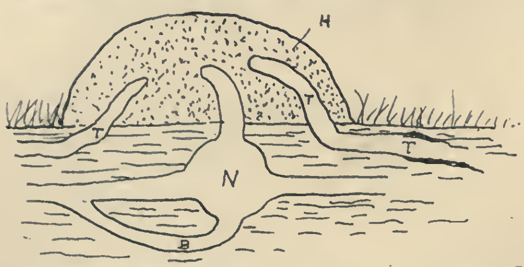


FIG. 3.—Sectional view of the completed fortress. T T, Tunnels formed in piling up earth from outside to make the nest rainproof.

A fortress is often completed in a single night. The young are not born in the winter "fortress," but in a separate habitation made by the female alone. It is built on the same plan as the "fortress," but usually simpler in construction and without the bolt-run. The female produces only one litter a year, and the young, which are born from the end of April to the end of May, vary in number from two to six. Naked, blind, and pink, they turn lead-colour in ten days; after a fortnight a grey velvet pelage is visible, which becomes black at the end of three weeks, when the eyes open. The ears are opened on the seventeenth

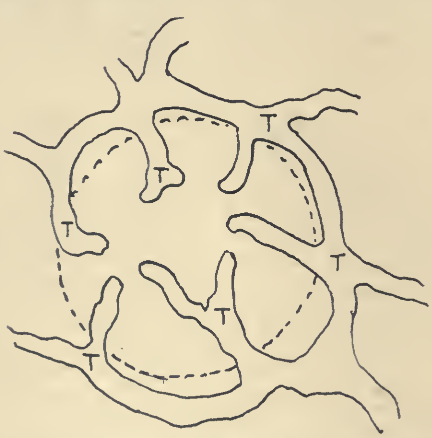


FIG. 4.—The completed fortress viewed from above, with the tunnels T T, &c., laid bare.

day. Attempts to rear the young by hand have hitherto proved futile, for, though they will suck freely from flannel or cotton wool soaked in warm milk, they pine and die on the third or fourth day.

There has always been much discussion as to the mole's power of sight. Dissection has shown that the size of the eye is greater in the embryo than in the adult, indicating that the sight of the race has deteriorated. From numerous experiments the writer is convinced that the adult mole is practically blind. Moles encountered in the day-time have taken no notice of a human being waving a hand close in front, nor at night do they show signs of consciousness of a light waved before their nose; but, if the slightest sound is made, the greatest excitement is instantly shown. The writer has often thrown down worms before a captive mole to test the sight. At once the mole becomes aware of the worm, but the haphazard way in which he will poke about for it with his snout shows clearly that he is guided by scent, and perhaps by hearing, but not by sight. It is true that at the least excitement the fur will radiate round the minute eye, and it has been suggested that the animal thus clears his eye to see; most probably, however, this mechanical action is retained though no longer of use, since the blind eye cannot benefit thereby. When, after a hurried and blundering search, the worm has been located, the mole holds it down with his fore paws and eats it from end to end with quick, jerky bites. When the animal's immense appetite is at length satisfied and worms are still being supplied, the mole will often give the worm several bites to disable it. and will then cram it into the earth, presumably to bury it for future use—after the manner of the dog with bones and the squirrel with acorns.

The senses of smell and hearing must be very acute to enable the mole to locate a pheasant's or partridge's nest above his run. That this is the case is testified

Photo. by *T. Bellchambers.*

FIG. 5.—Young moles ready to leave the nest.

by two gamekeepers in different parts of the country, both of whom state that the nests are often entered from below and the eggs eaten.

It is surprising how soon a captive mole becomes indifferent to being handled. Within half an hour of capture it may be stroked and scratched without causing alarm; the writer has even suspended one by the tail without causing the animal to cease from lapping water. Of course, gentle handling is necessary, and avoidance of any sudden or jerky movement. Another mole soon learnt to come out of his nest and look for worms when the writer scratched the side of the packing-case in which the captive dwelt.

LIONEL E. ADAMS.

THE SOUNDS OF THE HEART.[1]

THE sounds of the heart have always occupied the attention of physiologists both as regards their cause and as to their relations in time to other phenomena of the circulation, such as the impulse of the heart on the wall of the chest, and the pulse in arteries and other organs more or less distant from the heart. During the last few years much attention has been paid to these time-relations, and much

[1] Phono-Kardiogramme von Prof. Otto Weiss. (Jena: Gustav Fischer, 1909.) From Prof. E. Gaupp and Prof. W. Nagel's *Sammlung Anatomischer und Physiologischer Vortrage und Aufsatze.* Heft 7. A full bibliography will be found in Prof. Weiss's paper. Pp. 37. Price 1.50 marks.

ingenuity has been shown in devising methods by which the vibrations of those sounds, as distinct from the movements of the heart itself and the pulse in vessels, can be recorded. The older methods were subjective, and were consequently deficient in scientific accuracy. Thus, if even a skilled observer listened to the heart sounds and endeavoured to register their sequence by closing a key which acted on a recording lever, and if he endeavoured thus to register the moment of the occurrence of the first or second sound, or both, there was the inertia of the apparatus and the possibility of personal error, which made the observations of little value. It was desirable to have objective methods by which the vibrations could be actually recorded, and when one listens with the stethoscope to the strangely muffled sounds, one realises that to record the vibrations of such sounds is a remarkable achievement. At all events, the beginning and the end of the sounds can now be recorded.

Hürthle was the first to succeed in registering the vibrations of the heart sounds. This he accomplished in 1892. His method was dependent on the use of a microphone. A delicate microphone was placed on the prongs of a wooden tuning fork, and the latter was attached to the end of a large wooden stethoscope, resting on the chest wall, over the apex of the heart. The vibrations thus communicated to the microphone altered a current flowing through an electro-magnet, below which was placed a Marey's tambour (having a thin iron disc fixed to the india-rubber), and this, in its turn, transmitted its movement to a second very sensitive tambour, which recorded on a rapidly moving surface. In this way, vibrations of the heart tone were recorded, and information was obtained as to the exact moment when the tone began.

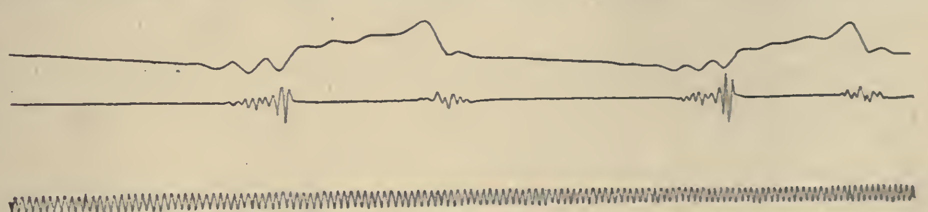
Soon afterwards, Einthoven investigated the subject by means of a microphone and capillary electrometer, and succeeded in registering with great accuracy the two tones. Then he employed his remarkably sensitive string galvanometer, and by means of this instrument, and with the aid of photography, the beginning, duration, and ending of the first and second sounds were recorded. Even in records from the impulse of the apex, which shows numerous vibrations, those associated with the heart sounds are readily identified. There can be little doubt that the string-galvanometer method is most to be depended on.

Holowinski developed a method by the construction of a kind of optical telephone. In the centre of a telephone disc, a plate of glass, like the cover-glass used in histology, was brought against a plano-convex lens, and in this way, when sounds caused the telephone plate to vibrate, the interference rings of Newton were produced. These varied with the heart tones, and, by a photographic method, when the picture of the variations was obtained, along with a superposed cardiogramme (registration of movements of apex impulse), Holowinski gave an interpretation showing the position of the tones. The picture so produced, although beautiful and interesting physically, is rather confusing.

Marbe devised a very delicate Marey's tambour, or rather capsule, by which the vibrations of the heart-tones regulated the flow of a current of acetylene gas. This passed to a burner. The flame moved up and down with each vibration, and it was allowed to impinge on a moving band of paper. On this, with each vibration, a ring of soot was formed, and a picture of the heart tones was imprinted on the paper. The method is easy, and the results are easily interpreted.

Another method has been devised by Gerhartz. He caused a membrane (which received the sound waves) to carry, vertically to its surface, a delicate glass rod, which, at the other end, bore a small metallic mirror, placed between the poles of an electro-magnet. The arrangement is somewhat complicated, and it did not give striking results.

The last method we shall notice is that of Prof. Otto Weiss. It is entirely mechanical, and is independent of microphones and electrical appliances, being a clever modification of the phonoscope, by which, some years ago, many were amused by watching the play of colours produced in a soap film by the sounds of speech. Weiss's method consists in the employment of a soap film, in the centre of which there is attached the end of a silvered thread. The other end of the thread is fixed to a lever connected with a carrier. Vibrations are carried by a special funnel-shaped tube from the heart to the phonoscope. This is enclosed in a box having in its walls lenses so adjusted that a photograph can be taken of the silvered thread and of its movements. The photograph, of course, is taken on a moving sensitive plate. The inertia of the system is remarkably small, the weight of the soap film and of the lever being about 0·000054 grm. All the parts are extremely light. The apparatus is so sensitive that the vibrations of a whisper can be recorded; the swing is aperiodic; and its moment of arrest is 0·01 sec. It is said to follow very frequent vibrations. An example of a tracing thus obtained is given in the figure.



Human Heart Sounds. The upper curve is a cardiogramme of the apex beat. The lower is that of 1/100 sec. The middle curve shows the heart sounds. Read from right to left. The first sound is the larger tracing. (Weiss.)

In his interesting monograph, Prof. Weiss gives examples of tracings of cardiac sounds along with the carotid pulse, of fœtal heart sounds, of the modifications of the sound caused by mitral insufficiency, mitral stenosis, aortic stenosis and insufficiency, and of anæmic sounds. All this shows the possibility of employing the method for clinical purposes. Finally, by an ingenious arrangement, Prof. Weiss has been able to reproduce the sounds by means of a telephone. A flame from a suitable lamp falls on a selenium cell in the circuit of which is a telephone. Interposed in the path of the beam of light, a disc is rotated having the curves of the heart sounds cut out on its margin. As it is rotated, the effect of the intermittent light on the selenium cell is such as to reproduce the heart tones in the telephone. Such an arrangement may be useful in teaching.

JOHN G. MCKENDRICK.

THE DAVY-FARADAY LABORATORY.

THE late Dr. Mond was keenly interested in the progress of science in all its branches, and his interest exhibited itself in a very practical manner. He was always ready to aid experimenters in carrying out costly researches, and his assistance enabled many young men to pursue original investigations of the most various kinds. Perhaps, however, the most conspicuous instance of his munificent aid to science was his founding of the Davy–Faraday laboratory. This institution was founded and maintained entirely at Dr. Mond's expense; its accommodation was placed at the disposal of investigators of all nationalities, and of both sexes, quite free of charge. It is probable that no institution of a precisely similar character is to be found elsewhere throughout the world; for it is not, in the general sense of the phrase, an educational institution: its staff comprises no one whose duty it is to give instruction, it has remained unconnected with the universities, and no sort of diploma is given to those who have worked there. It was intended to be of service to investigators, qualified by previous training to pursue original researches on their own initiative, and many such investigators have gratefully availed themselves of the facilities afforded to them.

At most institutions which foster original researches, the character of the work done is largely influenced by the professors in charge of the various departments; thus, to mention only one instance, students at the Cavendish Laboratory, Cambridge, have been engaged mostly in investigations connected with the ionisation of gases, under the inspiring influence of Sir Joseph Thomson; but at the Davy–Faraday laboratory, work of the most diverse kinds has been carried on. At the time when the present writer was privileged to occupy one of the rooms provided for investigators, researches were in progress in other rooms on such widely different subjects as the pressure produced during explosions, the rate of melting of ice under various conditions, the vapour pressure of strong solutions, the action of metals and other substances on photographic plates, the properties of platinum black, &c. It is possible that work of this character, ranging over most branches of physical and chemical science, has gained less public recognition than if a more restricted line of research had been pursued; but, for all that, the gain to science has been none the less real and lasting.

The Davy-Faraday laboratory was installed in a house adjoining the Royal Institution, Albemarle Street, and its name was chosen to honour the memory of two investigators whose labours have rendered the Royal Institution famous for ever. It was at first intended to endow the laboratory, and to place it entirely under the charge of the authorities of the Royal Institution; but, owing to some hitch in the negotiations to this end, a change of plan was decided upon: the laboratory was equipped at the expense of Dr. Mond, and a yearly grant was guaranteed for its maintenance, subject to the condition that, in the event of Dr. Mond or his heirs failing to provide this grant within a stated period of its falling due, the laboratory should become the property of the authorities of the Royal Institution.

The house in Albemarle Street was converted into a laboratory, or rather a series a laboratories, at great trouble and expense. A lift was provided for the conveyance of the workers to all floors of the building, and a well-furnished workshop was installed in the basement. In most cases workers occupy separate rooms, supplied with gas, water, and electricity; general laboratories, fitted for ordinary chemical work, can also be used. A wine-cellar was converted into a room in which researches, demanding constancy of temperature, can be pursued. Balance rooms, and rooms for the storage of apparatus and chemicals, were provided. In short, everything was done that could possibly aid in effectively converting a dwelling-house into an up-to-date laboratory. On the other hand, rooms in a dwelling-house can hardly be rendered suitable for certain classes of investigations, however much skill and foresight may be used in their conversion; thus, delicate optical researches are rendered difficult by the shakiness of the building. But for researches in physical chemistry, for which the laboratory was especially designed, the rooms are suited admirably; and most accessories required in such researches, including some of great value, are at the disposal of the workers; in this connection, a Rowland's concave grating, and its necessary adjuncts, may be mentioned. The valuable library in the Royal Institution is placed at the disposal of workers in the laboratory.

The laboratory has been managed by a committee which included Dr. Mond, Lord Rayleigh, and Sir James Dewar as members. This committee selects the candidates who can be accommodated in the laboratory; almost from the first the working space of the laboratory has been fully utilised. The staff of the laboratory includes the superintendent, Dr. Scott, F.R.S., several assistants, and a competent mechanic. When the present writer was working at the laboratory, a delightful *bonhomie* existed between the workers; and with so many specialists on different subjects congregated under one roof, the interchange of ideas was both stimulating and instructive, and one at least of the workers profited from it, and is glad of this opportunity to acknowledge his indebtedness; he is sure that everyone who has been privileged to work in the laboratory will associate the name of Dr. Mond with feelings of lasting gratitude, stronger than it has been possible to express in these brief and inadequate reminiscences of the Davy-Faraday Laboratory.

EDWIN EDSER.

NOTES.

THE Bakerian lecture of the Royal Society will be delivered on March 17 by Prof. J. H. Poynting, F.R.S., and Dr. Guy Barlow, upon the subject of "The Pressure of Light against the Source: the Recoil from Light."

WE notice with great regret the announcement of the death, at seventy-six years of age, of Dr. E. P. Wright, for many years professor of botany in Dublin University and keeper of the herbarium, Trinity College, Dublin.

DR. H. A. MIERS, F.R.S., principal of the University of London, has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

THE second annual Aëro and Motor-boat Exhibition is to be held at Olympia on March 11–19, under the patronage of the King. Reviewing the list of exhibitors, it appears that the monoplane will predominate, as most of the firms are devoting their attention to this type of aërocraft. In addition to the display of actual flyers, some ingenious models will be shown, while to the lover of mechanics the engines for aëronautical purposes will be of interest.

THE University of Kansas has lost its professor of mathematics by the sudden death, in his fiftieth year, of Prof. H. B. Newson. Prof. Newson was the managing editor of the University's Science Bulletin, and was the

author of numerous research articles in pure mathematics. He was a member, not only of the American Mathematical Society, but of the Deutsche Mathematike Vereinigung and the Circolo Matematico di Palermo.

THE ninth annual general meeting of the Association of Economic Biologists will be held at the University of Manchester on July 6–8, under the presidency of Prof. G. H. Carpenter. A detailed programme will be issued in due course; in the meantime, further particulars may be obtained from the honorary secretaries, Mr. W. E. Collinge, Uffington, Berkhamsted, or Mr. W. G. Freeman, 28 Burnt Ash Lane, Bromley, Kent. Mr. J. Mangan, of the University of Manchester, will act as local secretary.

FROM a Lick Observatory Bulletin we regret to learn of the death, at eighty-five years of age, of Mr. D. O. Mills, to whose generosity American astronomy—and higher education—owes very much. Mr. Mills was a member of the first board of trustees, appointed by James Lick, to superintend the construction and equipment of the Lick Observatory. To his benefactions the observatory was indebted for the two exceptionally fine spectrographs, used in connection with the great refractor, and he also provided the means necessary for the D. O. Mills expedition to the southern hemisphere, by which the observatory at Santiago, Chile, was established. His gifts to, and work for, the cause of higher education were also remarkable, both for the lavish manner in which they were freely given and the acute discernment which governed them.

THE following officers of the Pellagra Investigation Committee have been selected:—chairman, Sir T. Lauder Brunton; vice-chairman, Dr. F. M. Sandwith; honorary secretary and treasurer, Mr. J. Cantlie; advisory subcommittee, Mr. E. E. Austen, Prof. E. C. Bayly, Sir William Leishman, Dr. J. M. H. MacLeod, Sir Patrick Manson, Sir John McFadyean, Dr. F. W. Mott, and Prof. Ronald Ross. The field-workers will be Dr. Louis W. Sambon, of the London School of Tropical Medicine, and Captain J. E. Siler, with Mr. Arthur Dawson-Amoruso and Mr. G. C. C. Baldini as assistants. The standing commission for the investigation of pellagra in Bergamo has promised the inquiry every assistance.

THE eighth International Physiological Congress is to be held at the Physiological Institute of the University, Vienna, from September 27–30 next. Communications for the congress should be sent to Prof. O. v. Fürth, Physiologisches Institut, Wien IX., Wahringerstrasse 13. An exhibition of physiological apparatus is to be held from September 26 to October 1, and a special congress committee has been appointed to organise it; applications for permission to exhibit apparatus should be sent to Herrn Hofrat H. H. Meyer, Pharmakologisches Institut, Wien IX., Wahringerstrasse 13. Prof. E. B. Starling, F.R.S., of University College, London, is one of the general secretaries to the international committee, and Prof. Sigmund Exner, of the University of Vienna, is the president of the congress.

WE learn from *Science* that arrangements have been completed between Captain R. Amundsen and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington regarding cooperation in magnetic work on the proposed Amundsen Polar Expedition to leave Norway this summer on Nansen's vessel, the *Fram*. After some general explorations in the South Atlantic and in the South Pacific Oceans, the *Fram* is expected to arrive in the summer of 1911 at San Francisco, where her outfit will be completed. The vessel will then be headed for Bering Sea, and, after entering the polar basin, will drift with the ice. It is expected that it will be about four years before she emerges again from the ice. While Captain Amundsen hopes that his vessel will drift across the North Pole or close thereto, his prime object is that of general geographic exploration.

A BILL was introduced in the United States Senate on March 2 to incorporate a Rockefeller foundation in the district of Columbia. Mr. Rockefeller contemplates the endowment of an institution which will be greater even than the Carnegie foundation in educational work. The Senator who introduced the Bill said that Mr. Rockefeller had already given away 10,500,000*l*., and is now seeking legislative means to dispose of his fortune in a way most likely to benefit mankind. The foundation, according to the Bill, is to be organised to promote the well-being and advance the civilisation of the people of the United States and its possessions, and for the acquisition and dissemination of knowledge; for the prevention and relief of suffering, and the promotion of any and all elements of human knowledge. The amount of Mr. Rockefeller's fortune is not known precisely, but five years ago it was estimated at at least 100,000,000*l*.

THE following list of aviation meetings for the ensuing year is given by the *Deutsche Zeitschrift für Luftschiffahrt*:—March 25 to April 3, Cannes; (date not stated) Biarritz; April 10–25, Nice; April 30 to May 5, Tours; May 10–15, Bordeaux (national meeting); May 7–15, Lyon; May 10–16, Berlin (foreign competitors not disqualified); May 15–23, Marseille (national meeting); May 20–30, Verona; May 27–31, Limoges (national); June 5–22, Vichy (national); June 5–15, Budapest; June 5–12, Juvisy (national); June 18–24, St. Petersburg (foreigners eligible); June 10–26, Rouen; July 3–24, Rheims (French meeting); July 24 to August 4, Brussels; July 27 to August 2, Caen (national); August 6–13, England; August 6–21, eastern circuit; August 25 to September 4, Havre, Trouville; September 9–18, Bordeaux; September 24 to October 3, Milan; October 2–9, Juvisy (national); October 18 to November 2, America; December 4–18, Marseille.

A MEETING of the committee for an Arctic Zeppelin Airship Expedition was held in Hamburg on March 5 under the presidency of Prince Henry of Prussia. It was resolved to ask the Imperial Ministry of the Interior for the services of the Imperial exploration steamer *Poseidon* for ten or eleven weeks. The members of the expedition intend to start for Spitsbergen on July 1, and there to tranship to the *Poseidon*. At the same time dashes are to be made into the polar ice with the hired Norwegian iceship *Phoenix* to study the conditions for airship landing. The return will be made about the end of August. The Berlin correspondent of the *Westminster Gazette* states that the original idea of making the primary object of the expedition the reaching of the North Pale has been abandoned; the main purpose is now stated to be the exploration of the unknown regions north of Franz Josef Land and Spitsbergen. Cross Bay, which has been chosen on the ground of data determined by the Prince of Monaco, will be made the base of a number of separate airship voyages which the Zeppelin airship will make. On its way north over Germany and Norway the airship will stop at stations prepared in advance.

A REUTER message from Berlin states that Germany has decided to send out an Antarctic expedition. At a meeting of the Berlin Geographical Society on March 5, Lieut. Filchner was introduced to the meeting as the leader of

the forthcoming German expedition, and briefly outlined his plan of campaign. He proposes that the main expedition shall start from a base on Weddell Sea and advance straight across the Antarctic continent to the Pole. On reaching the Pole the expedition, instead of turning back, will proceed, probably following Sir E. Shackleton's route, to the coast of Ross Sea. Meanwhile, a subsidiary expedition will have landed on the shores of Ross Sea and have advanced inland along Shackleton's route about half-way to the Pole, where, after leaving a depôt of provisions, it will turn back to the coast. The main expedition, if all goes well, will pick up the depôt of provisions and join the subsidiary party at the coast. Lieut. Filchner hopes to be able to start in October. He has already had experience as an explorer in Central Asia, where he spent the years 1903 to 1905 in exploring Tibet. He has also done exploration work in the Pamirs and Turkestan. Dr. Penck, president of the Berlin Geographical Society, announced that an anonymous donor had promised 15,000*l.* towards the expenses, and Lieut. Filchner said he had received offers of aid amounting to 3000*l.* If two ships are chartered 100,000*l.* will be required, but if one only is sent out 60,000*l.* will suffice.

THE following are among the lecture arrangements at the Royal Institution after Easter:—Dr. A. Harden, three lectures on the modern development of the problem of alcoholic fermentation; Prof. F. W. Mott, three lectures on the mechanism of the human voice; Prof. A. E. H. Love, two lectures on earth tides; Prof. C. J. Holmes, two lectures on heredity in Tudor and Stuart portraits; Dr. Tom G. Longstaff, three lectures on the Himalayan region; Mr. W. McClintock, three lectures on Blackfeet Indians in North America; Dr. W. Rosenhain, two lectures on the constitution and internal structure of alloys; Major Ronald Ross, two lectures on malaria; Mr. W. W. Starmer, three lectures on bells, carillons, and chimes; Dr. D. H. Scott, three lectures on the world of plants before the appearance of flowers; Prof. J. A. Fleming, two lectures on electric heating and pyrometry (the Tyndall lectures). The Friday evening meetings will be resumed on April 8, when a discourse will be given by Prof. P. Lowell on the Lowell Observatory photographs of the planets. Succeeding discourses will probably be given by Prof. W. J. Pope, Mr. T. Thorne Baker, Dr. Tempest Anderson, Sir Almroth E. Wright, Prof. W. H. Bragg, Sir David Gill, Captain R. F. Scott, the Right Hon. Sir Rennell Rodd, and other gentlemen.

THE director of the Meteorological Office has given notice that from April 1 forecasts of the weather prospects more than twenty-four hours ahead will be issued as opportunity is afforded. Applications have been received at the Meteorological Office from time to time for forecasts of weather several days in advance, in addition to, or instead of, the usual forecasts which refer to the twenty-four hours reckoned from the noon or midnight following the issue of the forecasts. According to the experience of the Meteorological office, the weather conditions do not usually justify a forecast detailing the changes of weather for consecutive days. There are a number of occasions in the course of the year when the distribution of pressure is typical of settled weather, and also occasions when the conditions are characteristic of continued unsettled weather. On these occasions, and on a few others when the sequence of the weather is of a recognised type, a sentence giving in general terms the outlook beyond the twenty-four hours of the definite forecast might be useful to the general public, and, as it could be justified by the statement of definite reasons for the inference, it would come within the general rules laid down by the office with reference to the issue of forecasts. An indication of the general prospect extending beyond the twenty-four hours' limit is frequently given in the "General Inference" which precedes the forecasts for the several districts on the sheet issued to newspapers. It is expressed in more or less technical language, and the application to the several districts might only be followed by persons acquainted with the terminology used in weather study. It is proposed, therefore, when the meteorological conditions permit, to supplement the forecasts for districts by a remark on the further outlook.

THE summary of the weather issued by the Meteorological Office for the week ending March 5 shows that the conditions were still very mild over the entire country, the excess of temperature being generally from 2° to 3°. The rainfall varied considerably in different parts of the country, but was nowhere very large, whilst there was an excess of sunshine in every part of Great Britain. On nearly all parts of the coast the temperature of the sea-water was warmer than during the corresponding period last year, the difference amounting to between 6° and 7° on the east and south-east coasts of England. The summary of the weather for the winter, comprised by the thirteen weeks ending March 5, shows that the temperature was generally in excess of the average, but not to any great extent. The rainfall was everywhere above the average, the greatest excess being 4·80 inches in the north-west of England and 3·40 inches in the south-west of England. The excess was more than 2 inches in every district of the United Kingdom, except in the north and east of Scotland and in the Channel Islands; the largest actual measurement was 16·49 inches, in the west of Scotland, and the least 7·14 inches, in the east of England. The duration of bright sunshine for the winter was everywhere in excess of the average, the greatest excess being sixty-two hours in the south-east of England, and more than fifty hours in the east and north-west of England and in the Midland counties; the absolutely longest duration was 236 hours, in the south-east of England, and the least 146 hours, in the north of Scotland.

IN *Man* for February Mr. A. M. Blackman publishes some interesting notes on Egyptian antiquities and customs. Several noted tombs of Sheykhs, with the rites performed at them, are described, such as the custom of sleeping in the sacred precincts, as was done at Greek shrines of Asklepius, and of hanging up bandages there as a charm to secure recovery from circumcision and other operations. The Copts, we are told, slay a sheep at the threshold as the bride enters the house. She must take care to cross it without staining her feet or clothes in the blood. Should this occur the marriage is deemed unlucky.

IN the *Gypsy Lore Journal* for January Mr. W. Crooke discusses the ethnographical results of the article published in vol. ii. of the journal by Mr. E. O. Winstedt on "Gypsy Forms and Ceremonies." An examination of this extensive collection of Gypsy rites and ceremonies might be expected to throw light on the supposed Indian origin of the Gypsies. The result is that, except in some not important cases, the analogy with Indian customs is not satisfactorily established. It would seem that most of the customs of the European Gypsies result from their long contact with western peoples, such as the inhabitants of Asia Minor and the Balkan Peninsula.

THE higher classes in India, particularly those who have assimilated some of the culture of the West, have been actively asserting their claims to political and social equality with Europeans. They are confronted with a

similar problem, which is likely to cause no little embarrassment. The depressed classes are now claiming similar rights from their higher brethren. The Pariahs of Madras have formed an organisation, and in Bombay the question is so serious that the Guicowar of Baroda has been moved to advocate more consideration for them. The movement has now spread to Bengal, where the Jugi weavers have issued a manifesto, prepared by Prof. Radha Govinda Nath, urging that they are really sprung from the Yogi ascetics, and are entitled to social status like that of Brahmans. They repudiate the theory generally held that they represent the decayed Buddhist communities, who on the decay of their faith were, like other depressed religionists, compelled to adopt menial occupations. It will be interesting to watch the reception which their claim receives from the Babus of Bengal.

To vol. xi. of the Proceedings of the Washington Academy of Sciences Dr. F. H. Knowlton contributes a paper to prove that the Hell Creek and Ceratops beds of Montana, which have been usually regarded as of Upper Cretaceous age, are really the equivalents in time of the Tertiary Fort Union formation. Evidence in favour of this view is stated to be afforded by the plants, invertebrates, and vertebrates of the formations in question, and the author concludes by the definite statement that the Hell Creek, Somber, and Ceratops beds are stratigraphically, structurally, and palæontologically inseparable from the Fort Union beds, and therefore of Eocene age. To this view Mr. T. W. Stanton, in the same issue, replies that, in his opinion, the Ceratops beds are of Cretaceous age on account of their stratigraphical relations, the pronounced Mesozoic character of the vertebrate fauna and its lack of Tertiary types, and the close relation of its invertebrates to those of the Cretaceous. The admitted relationship of the flora to that of the Eocene is regarded as of minor importance.

In Nos. 1 and 2 of the Research Bulletin of the State University of Oklahoma Mr. H. H. Lane describes the breeding and placentation of the nine-banded armadillo, and likewise proposes a revised classification of the Edentata. As a rule, this species produces four young at a birth, one for each of the four mammæ, and from the circumstance that in the cases which came under the author's observation the young in each litter were of the same sex, and were contained in a common chorionic vesicle, it is considered probable that they were all derived from a single fertilised egg, and that the sex is determined in the latter. The placenta is of a deciduate type intermediate in form between the zonary and the discoidal, and as this type does not precisely conform to the "placenta zono-discoidalis" of Strahl, it is proposed that it should be known as "placenta zono-discoidalis indistincta." The author divides the Edentata into the Tæniodonta (extinct), Xenarthra, Pholidota, and Tubulidentata. Wortman is considered to be justified—in opposition to the view of W. B. Scott—in regarding the Tæniodonta (or Ganodontia) as represented by the Conoryctidæ and Stylinodontidæ, in the light of unspecialised ancestral Edentates.

Dr. Raymond Pearl and Dr. Frank M. Surface have been studying the egg-production of selected fowls with the view of answering the question, "Is there a Cumulative Effect of Selection?" and their conclusions have been published under this title in the *Zeitschrift für induktive Abstammungs- und Vererbungslehre* (Band ii., 1909, Heft 4). Two distinct experiments were made. The first, inaugurated by the director of the Maine Agricultural Experiment Station and the late Prof. G. M. Gowell, consisted in the continued selection of fluctuating variations with the view of increasing the fecundity. The second dealt with the inheritance of fecundity. The experiments were conducted on a large scale, and yielded extremely interesting, although from the poultry farmer's point of view very disappointing, results. Systematic selection carried on for nine consecutive years yielded no increase in the average production of the flocks, nor was there any decrease in variability as regards egg-production. Egg-producing ability is apparently not inherited; on the contrary, the daughters of hens which laid 200 or more eggs *per annum* actually laid, on an average, a smaller number of eggs than the daughters of less prolific birds. These results seem to have an important bearing on the theory of natural selection.

Students of cytology who are interested in the dynamical aspects of the phenomena of karyokinesis will welcome a paper on this subject, by Prof. Angel Gallardo, in the *Archiv für Entwicklungsmechanik der Organismen* (Band xxviii., Heft 1), a separate copy of which has been sent to us by the author. Prof. Gallardo interprets the division of the cell as a bipolar phenomenon of an electro-colloidal character. He regards the cell as a complex mixture of positive and negative colloids of different potential, of electrolytes, and of neutral coagulated substances susceptible or not of induction. He considers that the chromatin carries a negative, and the cytoplasmic colloids a positive, charge. The centrosomes are supposed to be capable of acquiring a positive potential higher than that of the cytoplasm. This potential increases through unknown causes, and determines the division of the centrosome. The radiations which appear around the separating daughter-centrosomes are chains of force, formed by the orientation of cytoplasmic microsomes. The trajectories of the centrosomes during separation are the resultants of their mutual repulsion and of the attraction of the nucleus. The chromatin divides during the metaphase by repulsion of its chromosomes under a high negative potential, and the two groups of daughter-chromosomes separate under the double action of their mutual repulsion and of the attraction of the centrosomes. The two new nuclei thus formed attract the positive cytoplasm, and thus determine the division of the cell itself. The paper also contains a useful *résumé* of the views of other writers, such as Hartog and Delage, on this interesting subject.

A few years ago we noted with pleasure the commencement of the *Bio-chemical Journal*, and congratulated the editors, Prof. Benjamin Moore and Mr. Edward Whitley, of Liverpool, on their enterprise in starting a periodical in which bio-chemists could publish their researches. The chemical side of biological investigation is well to the fore at the present time; physiologists, pathologists, botanists, and others are devoting themselves to the unravelling of nature's secrets by chemical methods; chairs and lectureships in the subject are being established in our universities and colleges; the subject has a rapidly growing literature of its own, and journals dealing with it are published in Germany and America as well as in Liverpool. The undertaking has met with an unqualified success, and the first number of the fifth volume has just been published. The occasion is signalised by the appearance of the journal in a form more worthy of the matter it prints, both cover and the quality of the paper used being improved. The papers in it indicate the manifold way in which chemical research is invading all branches of bio-chemical study; the first, by Major Sutherland and Captain M'Cay, deals with the influence of salts on hæmolysins, with special

reference to the blood destruction which occurs in the tropical disease known as blackwater fever. This is followed by a note on a new method for determining the alkalinity of the blood, by Drs. Boycott and Chisholm. The editor and his colleagues contribute two important papers, one relating to the bearings of the physical properties of colloids and of adsorption on physiological problems, and the other to the properties of a new sapoglucoside obtained from Mowrah seeds. Papers on the action of ether on the circulation by Dr. Embley, and the influence of the pancreas on glycolysis in muscle by Dr. Simpson, bring the number to a conclusion. We have to congratulate the editors on their success in adding to British scientific literature a journal of such a high standard.

THE advantages offered to students of natural history by the opening of a "mountain" laboratory at Tolland, Colorado, situated at a considerable elevation, yet immediately accessible by train, forms the subject of an article contributed by Prof. F. Ramaley to the University of Colorado Studies (vol. vii., No. 1). Swamp meadow, grass-land, scrub, pine, and spruce forests are found in the immediate vicinity, while a short railway journey up or down gives access to Alpine conditions or vegetation of a warmer region.

A SECOND paper by Mr. E. P. Stebbing on undescribed species of Indian boring beetles of economic importance belonging to the family Scolytidæ is published as the second part of the zoological series of Indian Forest Memoirs. Three species of Scolytus were taken on the deodar; in this respect they agree with the American types which infest conifers, whereas the Japanese and European species, including the well-known *Scolytus destructor* of the elm, infest dicotyledonous trees. Four species of Tomicus were discovered on different conifers, and a fifth was collected on the sál tree, *Shorea robusta*. Two species of Pityogenes, also taken on coniferous trees, are remarkable for their wide distribution.

SYSTEMATIC papers are prominent in the first part of the twenty-fourth volume of Transactions and Proceedings of the Botanical Society of Edinburgh. A short list of seaweeds collected in the West Indian island of Dominica is contributed by Mr. S. Grieve, and Mr. A. Bennett discusses the validity of *Naias flexilis* and *Atriplex calotheca* as British and Scottish species respectively. Miss I. M. Hayward prefaces a list of Tweedside alien plants with the remark that wool is largely imported into the district; this probably explains the presence of two species of Senecio, a Helipterum and *Atriplex spongiosa*, all Australian plants, and *Cenia turbinata*, a common weed throughout Cape Colony. An anatomical description of thorny aërial roots of the palm, *Acanthorhiza aculeata*, is communicated by Miss B. Chandler. They emerge as soft green roots, but on lengthening shed their root-cap, and eventually become hardened into thorny structures; they function, at any rate in the early stages, as breathing roots.

AN elaborate and extremely useful account of the Indo-Malayan woods, with a systematic enumeration of the trees furnishing them, is presented by Dr. F. W. Foxworthy in the botanical series (vol. iv., No. 4) of the *Philippine Journal of Science*. The author has found it convenient to summarise largely under types known by recognised common names. Attention is especially directed to the great importance of the timbers furnished by trees of the family Dipterocarpaceæ, some of which are hardwoods, others are of soft or medium grades. "Rassak" applies to certain hardwoods yielded by species of Vatica and Cotylelobium; "yacal" is obtained from species of Shorea and Hopea. Softer woods, used for planks and light constructive work, known as "lauan," "meranti," and "almon," are yielded by other species of Shorea, Hopea, and Anisoptera. The family of Leguminosæ also supplies many valuable trees, to mention only the genera Albizzia, Intsia, and Pterocarpus. Details are furnished of Philippine ebony trees and substitutes for other standard timbers, and a number of illustrations taken from transverse sections of the woods are provided.

PROF. G. MERCALLI, of the University of Naples, has recently published a valuable report on the Messina earthquake (*Atti del R. Ist. d'Incorraggiamento di Napoli*, vol. vii., 1909), in which special attention is paid to the phenomena exhibited in the south of Calabria. Although there were no immediate precursors of the great shock, at least six slight tremors were felt during the previous month at Messina, Reggio, and other places within the meizoseismal area. The earthquake itself consisted of two shocks, or of two distinct phases, separated by a brief interval, the first part being the longer and the second the more violent, the whole shock lasting about forty seconds. On the map of the central area four isoseismal lines are drawn, the innermost being nearly elliptical, about 18–20 km. long from north to south, and about 10 km. wide, and agreeing closely with the curve laid down by Prof. Omori as bounding the strongly shaken area. The epicentre was evidently submarine, and its position cannot therefore be exactly determined. Prof. Mercalli, who has made a special study of the Calabrian earthquakes, states that two of the after-shocks of the great earthquake of 1783 originated in the same centre as the Messina earthquake, as well as four other shocks in the years 1509, 1599, 1780, and 1876.

THE current number of *Science Progress* contains the first part of a paper on recent hydrobiological investigations, by Mr. James Johnstone, of the Liverpool University Fisheries Laboratory. The paper deals with the results of the international explorations of the seas of north-western Europe, more particularly with those set forth in the papers of Nansen and Helland-Hansen, and examines the relation between the "Gulf Stream" (by which, it appears from the paper, is meant the Norwegian branch of the "Gulf Stream drift") and climate and crops in northern Europe. The series of curves worked out by Nansen and Helland-Hansen showing the remarkable parallelism between air temperature and sea temperature, growth of fir trees, and yield of various harvests in Norway is illustrated. In the absence of further investigation in lower latitudes in the open Atlantic it is still quite uncertain how far the sea temperature is determined by the varying proportions in which the northward moving water is derived from the equatorial currents, and the relations of cause and effect are still so obscure that it seems premature to conclude that it is "inevitable that the yield of the land-crops depends on the temperature of the sea."

A SOMEWHAT novel treatment of the hydrodynamical equations representing the general circulation of the atmosphere is given by Mr. F. R. Sharpe in the *American Journal of Mathematics*, xxxii., 1. Besides writing down, in polar coordinates, the equations of flow of matter and momentum for a viscous fluid, the author takes, in place of the ordinary adiabatic assumption, an equation representing the flow of energy, which latter is equivalent to the energy equation of the kinetic theory. Making use of the fact that the height of the atmosphere is a small fraction

of the earth's radius, an approximate solution is obtained in the first place neglecting, and in the second place taking account of, the earth's rotation. The author establishes an agreement at least of a qualitative character between the results of his theory and observed facts.

THE *Electrician* for February 11 contains a description, by Mr. P. A. Mossay, of a new arc-lamp known as the Timar-Dreger, which almost dispenses with mechanism and seems incapable of getting out of order. The two carbons are placed horizontally, the positive a few millimetres above the negative, and the arc forms and remains at the ends. To compensate for the want of symmetry of the light, a second pair of carbons is provided which point in the opposite direction to the first. Another new piece of apparatus of interest to illuminating engineers is the Lowden rotary mercury pump, described in the *Electrical Engineer* of the same date. The pump is not unlike the Gaede in general principle, and is much quicker in action than the pumps now used in evacuating incandescent lamps down to pressures at which blackening of the bulb is inappreciable.

FIVE years ago the geophysics laboratory of the Carnegie Institution of Washington commenced the task of redetermining, on the constant-volume nitrogen scale of temperature, the melting points of the metals from zinc to palladium. The work has now been completed, and the results are given by Messrs. Day and Sosman in the February number of the *American Journal of Science*. A platinum-rhodium thermometer bulb has been substituted for the one of platinum-iridium used in the earlier measurements, and the bulb has been surrounded by an atmosphere of nitrogen at about the same pressure as that in the bulb to prevent diffusion of the gas through the walls of the bulb. Greater uniformity of temperature throughout the furnace in the neighbourhood of the bulb has been secured, as the authors consider that this is the chief outstanding error in the use of the thermometer. By means of thermo-couples of platinum platinum-rhodium standardised by comparison with the nitrogen thermometer they find the following values of the melting points, which may be compared with those of Messrs. Waider and Burgess, of the Bureau of Standards, given in these columns on February 17:—cadmium, 320·0°; zinc, 418·2°; antimony, 629·2°; aluminium, 658·0°; silver, 960·0°; gold, 1062·4°; copper, 1082·6°; nickel, 1452·3°; cobalt, 1489·8°; palladium, 1549·2°.

THE first instalment of an article on the stability of flying machines, by Prof. Herbert Chatley, appears in *Engineering* for March 4. The author proceeds to inquire under what conditions such machines may be automatically stable; up to the present, only two types possessing this quality seem to have been discovered, viz. the automatic single-surface glider and the balanced glider. The first relies for its longitudinal stability on the variation of the centre of pressure with the angle of attack; the second relies on the variation in altitude of a balancer or tail surface. In each case a torque should come into existence which will bring the glider back to its original position. The author works out both cases mathematically, and points out for the first case that it is not only $\phi(\beta)$, the distance of the centre of gravity ahead of the centre of area of the plane expressed as a function of the angle of attack β, which decides the stability, but the rate of change of the torque M produced by a small alteration in β owing to a change in the velocity. There seems no doubt that surfaces which are concave on the under side are not stable without some balancing device. The question of oscillations is also discussed in this article.

BULLETIN No. 34, issued by the Engineering Experiment Station of the University of Illinois, contains an account of tests on a water-tube boiler having two types of tile-roof furnaces. The tests were conducted by Mr. J. M. Snodgrass, and in the first four the tubes of the lower row were completely surrounded by the tiles which formed the roof of the furnace; in the other four tests the under sides of the tubes were exposed to the action of the furnace gases, the roof tiles resting on the tops of the tubes. The last four tests show a slightly higher efficiency, more uniform fire control, and a lower temperature in the furnace, combustion chamber, and stack as compared with the first four tests. The covered tubes were shown to be superior in the matter of smokelessness. About 5 per cent. more water per pound of coal was evaporated with the exposed tubes, and the temperatures in the furnace and combustion chamber were found to be from 200° to 400° F. less with these tubes than with those wholly covered. Copies of the bulletin may be had gratis from W. F. M. Goss, University of Illinois, Urbana, Illinois.

MESSRS. MACMILLAN AND CO., LTD., have published the first part of a "Key to Hall and Stevens's School Arithmetic," prepared by Mr. L. W. Grenville. The price of this part is 4*s*. 6*d*.

THE *Amateur Photographer* of March 8 is a special issue, containing a number of fine reproductions of photographs, printed in two colours on art paper, as well as valuable notes on scientific and artistic aspects of photography. The price of this issue is only twopence, notwithstanding these special characteristics.

A POPULAR edition of the "Naturalist on the River Amazons," by the late Henry Walter Bates, F.R.S., has been published by Mr. John Murray at the price of 1*s*. net. We welcome the publication in cheap form of standard books of travel of this kind as being likely to interest the general reader in the work of scientific naturalists and explorers.

OUR ASTRONOMICAL COLUMN.

BRILLIANT FIREBALL OF FEBRUARY 27.—Mr. W. F. Denning writes:—"On February 27, at 6.55, a magnificent meteor was observed at various places. It fell slowly, and illuminated objects around like the bright ball of a Roman candle. The meteor is remarkable in two respects, namely, for its unusual proximity to the earth at the end of its career and for the intense green colour exhibited by its nucleus as it sailed down the sky. Several independent observers say the object apparently reached the horizon, or got within 2° or 3° of it, before it became extinct. Its height was certainly not more than twelve miles at the end of its luminous career, which occurred over a point about twenty miles west of the island of Anglesey. Possibly, indeed, the meteor may have fallen in the Irish Channel, but evidence must be awaited from places nearer the scene of the event than any we now possess.

"The radiant point seems to have been in the N. region of Cancer, and this is a place from which several large fireballs have been directed in past years at the end of February and early in March.

"There is good reason to suppose that the meteor penetrated our air strata so far as to arrive in a compact form and still luminous to within seven or eight miles of the earth's surface, but more exact observations can alone enable trustworthy figures to be deduced."

COMET 1910*a*.—Further light is thrown on the time and circumstances of the discovery of comet 1910*a* by Mr. Innes in a communication published in No. 4389 of the *Astronomische Nachrichten*, p. 338.

The earliest date on which the comet appears to have been seen in South Africa was January 12, when, at 14h. 25m. (G.M.T.), some workmen at the Transvaal Premier Diamond Mine saw it. They described it as an ordinary star with a tail to it, apparently a little to the right of the point where the sun rises. Apparently Mr. Innes was nearly as unfortunate as some London astronomers, for, having made a series of observations on the morning of January 17, he and his colleagues were prevented, by overcast skies, from seeing the comet again.

A number of observations now recorded in the same journal and in the *Comptes rendus* show that the comet's brightness decreased very rapidly after January 30, and this probably accounts for the disappointment of a large number of people in not seeing it after reading the accounts of its extraordinary brilliancy and beauty. M. Coggia found that on February 11 it was but a bright nebulosity about equally visible with a star of magnitude 8·4; on February 4 it was as faint as magnitude 7·6, and only showed faint traces of a tail near the nucleus.

Halley's Comet.—An interesting popular address delivered before the Jersey Society in London by Mr. W. B. Brodrick in December (1909) is now published in *Science Progress* (No. 15, p. 492). The address contains a discussion of the historical events which have coincided with the comet's known apparitions, especially that of 1066, and some interesting quotations from early writers are given.

It is now improbable that the comet will be seen again until the third week in April, when, until its transit on May 18, it will rise shortly before the sun almost due east.

The Sun-spots of September 25, 1909.—An interesting description of the sun-spots of September 25, illustrated by photographs taken with the Rumford spectroheliograph at the Yerkes Observatory, is given by Dr. Slocum in No. 1, vol. xxxi., of the *Astrophysical Journal* (January, p. 26). The history of the spot, shown to be connected with the magnetic storm of September 25, is given from its appearance on September 1 to November 19, when it was last seen, and the Yerkes observations confirm those made at South Kensington in showing that the spot was especially active at the time of the magnetic storm. On September 24 the high-level calcium flocculi showed a spiral form over the spot, but on September 25 this had disappeared, and was replaced by a number of bridges crossing the spot. On September 27 the arrangement of these bridges had changed completely, and there was again a trace of the spiral structure. A prominence plate taken on September 30, at 3h. 48m. G.M.T., showed that the spot area was still active, for there were several prominences at the region of the limb where the spot had disappeared; a second plate, taken at 4h. 57m. G.M.T., showed that in the interval a violent eruption had occurred, and in place of a small single prominence there was a brilliant one extending some 5° or 6° along the limb, and rising, in several arches, to a height of 32,000 km.

Displacement of Lines at the Sun's Limb.—In publishing his important results on the spectroscopic determination of the sun's period of rotation, Dr. Halm, in 1907, directed attention to several cases where there were small displacements, of certain lines, independent of those due to rotation. Since then the matter has been under investigation at Mount Wilson, and Mr. W. S. Adams now publishes, and discusses at length, the results obtained. Too many points of interest are raised in his paper to be discussed adequately here, but one or two of the chief ones may be briefly referred to.

A great deal of the work has been carried out with the 30-foot spectrograph, used in connection with the tower telescope, thus providing photographs of large dispersion.

Seven classes of lines were selected for special discussion, so that any differential effects might be the better investigated, and altogether 470 lines were dealt with; the intensities at limb and centre, the displacement, and various remarks are tabulated for each line. Two values for the displacement are given, one the observed value, the other the value obtained after applying to this a correction of 0·002 Å, indicated by the cyanogen bands as being probably due to motion in the line of sight produced by convection currents in the values for the centre.

These results show that the lines of titanium, vanadium, and scandium are less displaced than those of iron and nickel, and this is considered to be an indication that the cause producing the relative "shifts" is most effective at the lower levels. Lines most strengthened at the limb generally show the smaller displacements, and the explanation offered is that the intensification is a temperature effect, the higher level lines being cooler; the smaller displacement is thus in accordance with the previous conclusion.

The enhanced lines are well marked in the results, and generally show a much greater displacement than the arc lines. This is especially prominent in the case of lines extremely weak in, or absent from, the arc spectrum, as shown by the special study of eighteen lines given in Lockyer's list of the enhanced lines of iron; the line at λ 4385·548 gives a larger displacement (+0·013 Å.) than any other line on the more refrangible side of λ 5500. The suggested explanation of this peculiarity of enhanced lines is that, in the solar spectrum, they are due almost exclusively to the "granulations" on the disc. If, as has been suggested, these granulations signify masses of ascending, heated vapours, the measures at the centre would be affected by the resulting differential motion in the line of sight, and so increased displacements would result; an upward motion of 0·12 km. per sec. in the granulations would account for the results found.

Finally, the results indicate that the relative displacements are caused by pressure, although this is a general result to which there are exceptions, which further investigations may adequately explain. The action of magnetic fields, of anomalous dispersion, and various other causes are referred to, but more evidence is necessary ere their definite relation can be inferred.

The "Anuario" of the Madrid Observatory, 1910.—From the Madrid Observatory we have received a copy of their "Anuario" for 1910, a useful volume containing the usual astronomical tables and some interesting articles on astronomical subjects. There is also a *résumé* of the solar observations made at the observatory during 1908, containing a complete daily, and summarised, record of the prominence observations, and a similar *résumé* of the meteorological observations.

THE ORGANISATION OF INDUSTRIAL RESEARCH.

An address delivered by Mr. W. R. Whitney at the twentieth anniversary of Clark University, and reprinted from the Journal of the American Chemical Society in two recent numbers of the *Chemical News*, contains many suggestive and valuable passages, expressed with characteristic forcefulness. As the author is himself at the head of a staff of eighty investigators, he is well qualified to speak on the "Organisation of Industrial Research." In his view the fundamental problem is to secure men who are endowed with the essential qualities of optimistic activity and knowledge; the former he regards as of supreme importance, in view of the fact that general laws usually indicate the impossibility of a process rather than the specific conditions under which success may be achieved. Fortunately this quality can be imparted, as has been proved again and again, by the establishment of "schools" of research, many of which have become world-wide in their operation; fortunately, also, it is possible by suitable organisation to utilise the labours of those who are not so endowed to promote the achievement of the ideals conceived by the few who are; and in such an organisation it is urged that the output should be not merely proportional to the number employed, but to some higher exponential function. In such a complex scheme it is not thought to be possible to reward each investigator by royalty or by any such direct payment for his success in making discoveries of definite commercial value, on one hand because his success is only in part due to his own efforts, and on the other hand because each investigator must be freely available for carrying on lines of work in which success of this kind is not likely to ensue.

In regard to material equipment, the author holds views of a very advanced character. Necessity is not the mother of invention; knowledge and experiment are its parents. This is clearly seen in the case of many industrial discoveries; high-speed cutting tools were not a necessity which preceded, but an application which followed, the discovery of the properties of tungsten-chromium-iron alloys; so, too, the use of titanium in arc lamps and of vanadium in steel were sequels to the industrial preparation of these metals, and not discoveries made by sheer force of necessity. Much the same consideration applies to the equipment of an industrial laboratory, where the most useful tools were often acquired with no idea of the uses to which they would ultimately be put. "No good tool lives long for a single use alone. Many times we have questioned the advisability of installing some new apparatus—a vacuum furnace, a pair of metal rolls, some special galvanometer, some microscope, a hydraulic press, a power hammer, a steam digester, &c. Never, after it became a part of the equipment, has it seemed possible to proceed without it. In the single case of the electric vacuum furnace, for example, our laboratory has made almost continual use of from three to eight for the past five years. The laboratory, piped several years ago with high vacuum and with electrolytic hydrogen, besides steam, air, water, and gas, will probably never operate without them."

Similar considerations apply to a library. A library containing ten of the leading research journals of the world may be said to have in each volume about 100,000 brainpower hours, and it would be folly not to utilise a charged storage-battery of this immense capacity when it can so readily be installed.

SOME RECENT APPLICATIONS OF OZONE.

ALTHOUGH ozone has now been definitely known for nearly seventy years, its commercial production and exploitation is one of the many bye-products that have resulted from the modern development of electrical engineering. The "Ozonair" Company, of 96 Victoria Street, Westminster, has taken advantage of these developments to produce a series of compact and (in many cases) portable ozonisers which can be connected directly to the ordinary lighting circuits and set in operation by means of a couple of tumbler switches, one controlling a fan or blower, and the other a coil or transformer for energising the aluminium gauze in contact with which the ozone is produced. The simplicity of these arrangements should prove an important factor in securing the general utilisation of ozone in all those cases in which its usefulness has been conclusively demonstrated.

Most of the new designs are intended for the purification of air, and in the case of large buildings their utility and efficiency can scarcely be doubted. In a small room or in close proximity to a generator, the presence of an excess of ozone might well be disagreeable, as those who have worked with it have good reason to know, but in a crowded hall the atmosphere of a public meeting would stand to gain enormously by the freshening and purifying effects of one or two well-placed ozonisers. In cases such as the above it is difficult, and in many buildings impossible, during the winter to introduce enough air from outside to prevent the atmosphere from becoming "stuffy," but the most dangerous and unpleasant effects might well be got rid of by means of ozone.

This general idea has been worked out into a definite and novel scheme of ventilation, which is acquiring considerable popularity in Russia, where warmth and freshness have usually presented themselves as alternatives rather than as compatible qualities, and in the tropics, where the introduction of large volumes of air from the outside is sufficient to destroy whatever remnants of coolness may be retained by the use of verandahs and other devices for excluding the glare of the sun. In each of these widely differing circumstances the method used is to withdraw air from the room, purify it by screening, washing, and ozonising, cool or warm as the case may be, and return it to the room with a sufficient admixture of outside air to keep the proportion of carbon dioxide within reasonable limits. In this way a great economy of heating or cooling is achieved, whilst the wholesomeness of the atmosphere is fully maintained.

The sterilisation of air by means of ozone has found a widespread application in brewing, where it replaces with great advantage the cumbrous and only partially effective systems of air-filtration that have been employed to protect the wort during fermentation, cooling, refrigerating, and bottling; it is also of service in protecting the yeast from contamination whilst it is being drained off from the wort.

An application of ozone of a more familiar type is in the bleaching of palm-oil for soap-making. This has usually been effected by means of bichromate and muriatic acid at a cost which may amount to as much as 30*s.* per ton. The bleaching of the oil by ozone is very effective, even in the case of specially bad samples, and costs little more than a tenth of this sum; in addition, the dark sediment that is thrown out during purification is much smaller in bulk, and the waste of oil is therefore greatly reduced.

It is claimed that the ozonised air produced by the new types of apparatus is entirely free from oxides of nitrogen, a point of considerable importance in many of its commercial applications.

AMERICAN ECONOMIC ENTOMOLOGY.

ACCORDING to the twenty-fifth report of the State Entomologist on the noxious and beneficial insects of Illinois, the scope of the work of the Entomological Department of that State has been very largely increased as the result of special legislative enactments, and the present report is the first to be drawn up under the new conditions. Its contents consist of three articles, one on experiments to check the corn-root aphis, a second on the habits of the corn-field ant (*Lasius niger americanus*), and a third on the insects infesting clover and alfalfa. Since all three have been already issued as Bulletins of the Agricultural Experiment Station of Illinois University, they need not be further noticed.

The mites of the group Oribatoidea form the subject of an article in vol. vii. of the Bulletin of the Illinois State Laboratory of Natural History. These mites, which are not much larger than the head of an average pin, are characterised by their hard, chitinous integument, on account of which they are commonly spoken of as beetle-mites, although they are not to be confounded with the mites infesting coprophagous beetles. They are generally found under decaying timber, beneath bark, under stones, in moss or grass, or on the twigs of trees, and do not appear to inflict any special damage on crops. In the present article Mr. H. E. Ewing describes a number of new species.

In article 2 of vol. viii. of the same publication Mr. J. D. Hood gives descriptions of new generic and specific types of thrips of the group Thysanoptera from Illinois.

Army-worms and cut-worms infesting sugar-cane in the Hawaiian Islands form the subject of Bulletin No. 7 of the Entomological Division of the Experiment Station of the Hawaiian Sugar-planters' Association, published at Honolulu. Of the various species of "army-worms," the widely spread *Cirphis unipuncta* is abundant in the islands, but the larvæ do not seem to assemble in the hordes which have given rise to the name of the group. They inflict, however, considerable damage on young sugar-cane, although, fortunately, there is an interval between the disappearance of one brood and the development of a second, which affords time for the plants to recuperate. The numbers of the grass army-worm—the caterpillars of the moth *Spodoptera mauritia*, a species indigenous to Mauritius, western Africa, and the Oriental and Australasian regions—have been kept in check in Hawaii, where they formerly did much damage, by the introduction of myna birds from India.

Since weevils are a group with which the economic entomologist has many dealings, reference may be made here to a paper on North American Curculionidæ, by Mr. W. D. Price, published as No. 1708 of the Proceedings of the U.S. National Museum. A number of new species are named and described.

COLOURS OF SEA AND SKY.[1]

A RECENT voyage round Africa recalled my attention to interesting problems connected with the colour of the sea. They are not always easy of solution in consequence of the circumstance that there are several possible sources of colour the action of which would be much in the same direction. We must bear in mind that the absorption, or proper, colour of water cannot manifest itself unless the light traverse a sufficient thickness before reaching the eye. In the ocean the depth is, of course, adequate to develop the colour, but if the water is clear there is often nothing to send the light back to the observer. In these circumstances the proper colour cannot be seen. The much admired dark blue of the deep sea has nothing to do with the colour of water, but is simply the blue of the sky seen by reflection. When the heavens are overcast the water looks grey and leaden; and even when the clouding is partial, the sea appears grey under the clouds, though elsewhere it may show colour. It is remarkable that a fact so easy of observation is unknown to many even of those who have written from a scientific point of view. One circumstance which may raise doubts is that the blue of the deep sea often looks purer and fuller than that of the sky. I think the explanation is that we are apt to make comparison with that part of the sky which lies near the horizon, whereas the best blue comes from near the zenith. In fact, when the water is smooth and the angle of observation such as to reflect the low sky, the apparent blue of the water is much deteriorated. In these circumstances a rippling due to wind greatly enhances the colour by reflecting light from higher up. Seen from the deck of a steamer, those parts of the waves which slope towards the observer show the best colour for a like reason.

The real colour of ocean water may often be seen when there are breakers. Light, perhaps directly from the sun, may then traverse the crest of the waves and afterwards reach the observer. In my experience such light shows decidedly green. Again, over the screw of the ship a good deal of air is entangled and carried down, thus providing the necessary reflection from under the surface. Here also the colour is green.

The only places where I have seen the sea look blue in a manner not explicable by reflection of the sky were Aden and Suez. Although the sky was not absolutely overcast, it seemed that part, at any rate, of the copious if not very deep blue was to be attributed to the water. This requires, not only that the proper colour of the water should here be blue, but also the presence of suspended matter capable of returning the light, unless, indeed, the sea-bottom itself could serve the purpose.

The famous grotto at Capri gives an unusually good opportunity of seeing the true colour of the water. Doubtless a great part of the effect is due to the eye being shielded from external glare, and so better capable of appreciating the comparatively feeble light which has traversed considerable thicknesses of water. The question was successfully discussed many years ago by Melloni, who remarks that the beauty of the colour varies a good deal with the weather. The light which can penetrate comes from the sky, and not directly from the sun. When the day is clear the blueness of the sky cooperates with the blueness of the water.

That light reflected from the surface of a liquid does not exhibit the absorption colour is exemplified by brown peaty water such as is often met with in Scotland. The sky seen by reflection is as blue as if the water were pure; but an attempt to illustrate this fact by experiment upon quite a small scale was not at first successful. A large white photographic dish containing dark-brown oxidised "pyro" was exposed upon the lawn during a fine day. Although the reflected light certainly came from the clear sky, the colour did not appear pronounced, partly in consequence of the glare of the sunshine from the edges of the dish. The substitution of a dish of glass effected an improvement; but it was only when the eye was protected from extraneous light by the hands, or more perfectly by the interposition of a pasteboard tube held close up, that the blue of the reflected light manifested its proper purity.

It would seem that the explanation is to be sought in diffusion of light within the lens of the eye, in consequence of which, especially in elderly persons, the whole field is liable to be suffused with any strong light finding access.

As regards the proper colour of pure water, an early opinion is that of Davy, who, in his "Salmonia," pronounces in favour of blue, basing his conclusion upon observations of snow and glacier streams. The latter, indeed, are often turbid, but deposit the ground-up rock which they contain when opportunity offers, as in the Lake of Geneva. A like conclusion was later put forward by Bunsen on the basis of laboratory observations. The most elaborate experiments are those of Spring, who, in a series of papers published during many years, discusses the difficult questions involved. He tried columns of great length—up to 26 metres; but even when the distance traversed was only 4 or 5 metres, he finds the colour a fine blue only to be compared with the purest sky-blue as seen from a great elevation; but when the tubes contain ordinary water, even ordinary distilled water, the colour is green or yellow-green, and not blue.

The conversion of the original blue into green is, of course, explicable if there be the slightest contamination with colouring matter of a yellow character—*i.e.* strongly absorbent of blue light. Spring shows that this is the effect of minute traces—down to one ten-millionth part—of iron in the ferric state or of humus. The greenness of many natural waters is thus easily understood. Another question examined by Spring is not without bearing upon our present subject, viz. the presence of suspended matter. I am the better able to appreciate the work of Spring, that many years ago I tried a variety of methods, including distillation *in vacuo*, in order to obtain water in the condition which Tyndall described as "optically empty," but I met with no success. Spring has shown that the desired result may be obtained by the formation within the body of the liquid of a gelatinous precipitate of alumina or oxide of iron, by which the fine particles of suspended matter are ultimately carried down.

Perhaps the most telling observations upon the colour of water are those of Count Aufsess, who measured the actual transmission of light belonging to various parts of the spectrum. The principal absorption is in the red and yellow. In the case of the purest water, there was practically no absorption above the line F, and a high degree of transparency in this region was attained even by some natural waters. That these waters should show blue, *when in sufficient thickness*, is a necessary consequence.

In my own experiments, made before I was acquainted with the work of Aufsess, the light traversed two glass tubes of an aggregate length of about 4 metres (12 feet). On occasion the light was reflected back so as to traverse this length twice over. I must confess that I have never seen a blue answering to Spring's description when the original light was white. For final tests I was always careful to employ the light of a completely overcast day, which was reflected into the tubes by a small mirror. The colour, after transmission, showed itself very sensitive to the character of the original source. The palest clear sky of an English winter's day gave a greatly enhanced blue, while, on the other hand, isolated clouds are usually yellowish, and influence the result in the opposite direction. I should myself describe the best colour of the transmitted light on standard days as a greenish-blue, but there is some variation in the use of words, and, perhaps, in vision. Some of my friends, but not the majority, spoke of blue simply, but all were agreed that the blueness of a good sky was not approached. The waters tried have been very various. Sea-water from outside the grotto of Capri, from Suez, and from near the Seven Stones Lightship, off the Cornish coast, I owe to the kindness of friends. Of these, the two former showed a greenish-blue, the latter a full, or, perhaps, rather yellow-green, and these colours were not appreciably modified after the water had stood in the tubes for weeks. It is important to remember that the hue may, to some extent, depend upon thickness. It is quite probable that in a greatly increased thickness the Capri and Suez waters would assume a more decided blue colour; but I do not think the Seven Stones water could so behave, the colour, with 12 feet, seeming to involve the absorption of blue light.

[1] Discourse delivered at the Royal Institution on Friday, February 25, by the Right Hon. Lord Rayleigh, O.M., F.R.S.

Further observations on greater depths of sea-water would be desirable. A naval son informs me that off the coast of Greece a plate lying in 6 fathoms of water looked decidedly blue, although the sky was a dirty grey. I have doubts whether this would be generally the case in the Mediterranean; the green due to moderate thicknesses seems too decided.

Of natural fresh waters that I have tried, none was better than that from a spring in my own garden. This water is hard, but bright and clear, and it shows a greenish-blue, barely distinguishable from that of the Capri and Suez water. Distillation does not improve the blue. Neither did other treatments do any good, such, for example, as partial precipitation of the lime with alkali, or passage of ozone with the idea of oxidising humus. Wishing to try water of high chemical purity, I obtained—through the kind offices of Sir J. Dewar—water twice distilled from alkaline permanganate, and condensed in contact with silver, but the colour was no bluer. In the light of this evidence I can hardly avoid the conclusion that the blueness of water in lengths of 4 metres has been exaggerated, especially by Spring, although I have no reason to doubt that a fully developed blue may be obtained at much greater thicknesses. I should suppose that sufficient care has not been taken to start with white light. It may be recalled that overcast days are not so common in some parts of the world as in England.

A third possible cause of apparent blueness of the sea must also be mentioned. If a liquid is not absolutely clear, but contains in suspension very minute particles, it will disperse light of a blue character. Although, undoubtedly, this cause must operate to some extent, I have seen no reason to think that it is important; but the existence of three possible causes of blueness complicates the interpretation of the phenomena. Hitherto observers have not been sufficiently upon their guard to distinguish blueness having its origin in the sky from blueness fairly attributable to the water itself.

As regards the light from the sky, the theory which attributes it to dispersal from small particles, many of which are smaller than the wave-length of light, is now pretty generally accepted. To a first approximation, at any rate, both the polarisation and the colour of the light are easily explained. According to the simplest theory, the polarisation should be absolute and a maximum at 90° from the sun, and the colour should be modified from that of the sun according to the factor λ^{-4}; but it is easy to see that there must be complications, even if all the particles are small and spherical. The light illuminating them is not merely the direct light of the sun, but also light diffused from the sky and from the earth's surface. On these grounds alone the polarisation must be expected to be incomplete even at 90°, and the certain presence of particles not small in comparison with the wave-length is another cause operating in the same direction. It is rather remarkable that, as I noticed in 1871, the two polarised components show much the same colour. The observation is best made with a double-image prism mounted near one end of a pasteboard tube, through which a suitable rectangular aperture at the other end is seen double, but with the two images in close juxtaposition. When this is directed to a part of the sky 90° from the sun, and the tube turned until one image is at its darkest, the two polarised components are exhibited side by side in a manner favourable for comparison of colours. The addition at the eye end of a Nicol capable of rotation independently of the tube gives the means of equalising the brightnesses without altering the colours. This observation, made independently by Spring, is regarded by him as an objection to the theory, and as showing that the cause of the blueness and of the polarisation is not the same. The argument would have more weight if the colours of the two components were exactly the same and in all circumstances, but I do not think that this is the case. Observations on the purer sky, to be seen from great elevations, would be of interest. The question is to what causes the second component is principally due. So far as it depends upon sky illumination, it would be bluer than the first component. Any "residual blue" of the kind described by Tyndall, and due to particles somewhat too big for the simple theory, would make a contribution in the same direction. On the other hand, large particles under the direct light of the sun, and perhaps small ones, so far as illuminated by light from the earth, would contribute a whiter light. In this way an approximate compensation may occur, but the matter is certainly worthy of further attention.

In this connection it should be noticed that, according to the now generally received electromagnetic theory, complete polarisation at 90° requires that the dispersing particles should behave as if spherical, even although infinitely small. If the shape be elongated, there would be incomplete polarisation combined with similarity of colour even under the simplest conditions.

When the particles are no longer very small in comparison with the wave-length, the direction of maximum polarisation was found by Tyndall to become oblique, and the deviation is in the opposite direction to that which would have been anticipated from the Brewsterian law for the reflection of light from surfaces of finite area. As I showed in 1881, the gradual precipitation of sulphur from a very weak and acid solution of "hypo" exhibits the phenomena remarkably well. At a certain stage, depending on the colour of the light, the direction of maximum polarisation becomes oblique. Even when the obliquity is well established for blue light, red light still continues to follow the simpler law, and the comparison gives curious information concerning the rate of growth of the particles.

The preferential scattering of light of short wave-length involves, of course, a gradual yellowing and ultimate reddening of the light transmitted. The formation in this way of sunset colours is well illustrated by the acid hypo.

That Spring rejects this theory in favour of one which would attribute sky-blue to absorption by oxygen or ozone has been already alluded to. Although one must not conclude too hastily from the behaviour of these bodies when liquefied, it is, of course, possible that their absorbing qualities may influence atmospheric phenomena in some degree; but to attribute the blue of the sky to them seems out of the question. It is sufficient to remark that the setting sun turns red, and not blue.

An interesting question remains behind. To what kind of small particles—dispersing short waves in preference—is the heavenly azure due? That small particles of saline or other solid matter, including organic germs, play a part cannot be doubted, and to them may be attributed much of the bluish haze by which the moderately distant landscape is often suffused; but it seems certain that the very molecules of air themselves are competent to scatter a blue light not very greatly inferior to that which we actually receive. Theory allows a connection to be established between the transparency of air for light of various wave-lengths, and its known refractivity in combination with Avagadro's constant, expressing the number of molecules per cubic centimetre in gas under standard atmospheric conditions. The first estimate of transparency was founded upon Maxwell's value of this constant, viz. $1 \cdot 9 \times 10^{19}$. Recent researches have shown that this number must be raised to $2 \cdot 76 \times 10^{19}$, and that the result is probably accurate to within a few per cent.[1] It has been pointed out by Dr. Schuster that the introduction of the raised number into the formula almost exactly accounts for the degree of atmospheric transparency observed at high elevations in the United States, apparently justifying to the full the inference that the normal blue of the sky is due to molecular scattering; but, although there is no reason to anticipate that this general conclusion will be upset, it should not be overlooked that a molecule, especially a diatomic molecule, can hardly be supposed to behave as if it were the dielectric sphere of theory. Questions are here suggested for the decision of which the time is perhaps not yet ripe.

P.S.—The question of the colour of the Mediterranean and other waters was long ago discussed by Mr. J. Aitken—an excellent observer—in Proc. Roy. Soc. Edin., 1881–2. His principal conclusions are very similar to my own. Mr. Aitken rightly insists upon the influence of the colour of the suspended matter to which the return of the light

[1] It is a curious instance of divergence in scientific opinion that whil some still deny the existence of molecules, others have successfully counted them.

is due. Only when this is white has the proper colour of the water a full chance of manifesting itself. From the heights of Capri I noticed that the shallow water near the shore showed decidedly green, an effect attributed to the yellowness of the underlying sand.

A GEOLOGIC FORECAST OF THE FUTURE OPPORTUNITIES OF OUR RACE.[1]

THE established custom of occasions of this kind leads the association to expect that its retiring president will address it upon some theme connected with the field of his own work. I shall not altogether ignore this custom, but I have chosen a theme that is at once peculiarly humanistic and distinctly prophetic. Geology has not usually been regarded as in any special sense a humanistic science, much less a prophetic one. But it is just because it has not been so regarded, and because I have fondly dreamed that it might become tributary in an eminent degree to humanistic problems and to a prophetic insight, that I have chosen the theme assigned for the evening.

Ever since the race came to a virile state of intelligence, it has tried to peer into the future that it might guide itself by its foresight. Now and then it has prolonged its vision beyond mere temporary concerns, and has endeavoured to prophesy the end of the race and the destruction of the earth. At all stages the depth of its vision into the things before has been close akin to the length of its vision backward and to the depth of its insight into the things about it. The lamp of the past and the illumination of the present have been its light for the future. This must doubtless always be its true method, for only as the race sees far into the past, sees widely and deeply into the present, has it any firm basis for a confident prophecy of the future. Even in its early days, the race did not fail to note that—though this may not be so of the ultimate entities—the existing *forms* come into existence, live their day, and pass away; why not, therefore, the race and the earth on which it dwells? Even as the race grows into its fuller maturity and the horizon of its vision is enlarged, there will doubtless still remain the conviction that there has been a beginning of the current order of things, and a like conviction that there will be an end. The enlargement of vision will only serve to bring into view an additional multitude of organisms and organisations that have come into form, endured for a time, and passed away. Any future change in human forecasts is not likely to be one of method, but one of measure. Some of the features that have entered into former prophecies will no doubt disappear, and perhaps new ones be added. The forecasts of pre-scientific times often made the doom of the earth hinge on some lapse in the conduct of man—made a physical disaster serve as a moral punishment. With a better knowledge of the moral law and of man's place in nature, this anthropic view will no doubt give place to a more consistent insight into the sequences of the moral and the physical worlds.

In the earlier days of the race the backward look was short, and the putative origin of the race and of the earth was placed but a few thousand years in the past; in consonance with this, the forward look placed the end not far in the future. So, too, as the beginning was made chaotic, the end was made cataclysmic.

The dawn of the earth sciences was followed by a new forecast, and as these sciences grew this underwent revisions and recasts. It was learned that the history of the earth stretches back not merely for thousands but for millions and tens of millions of years; that the on-goings of the earth are actuated by energies too broad and deep and strong to be swerved in their course or brought to an end by the acts of those who dwell upon it; that the march of earth-history has a mighty tread not to be measured by the merits or lapses of even our favoured race.

The trend of prophetic thought in the last century invites a closer review. The basis of forecast lay fundamentally in the mode of origin assigned the earth and in the general trend of its past history, especially the trend of those agencies that controlled the conditions of life on its surface. The solar system was thought to have had its origin in a gaseous or quasi-gaseous nebula. The earth, as a member of the solar system, partook of this origin, and was conceived to have been, at an early stage, itself a fiery, gaseous globe. It is not needful here to review the special hypotheses or pay honour to their great authors from Kant and Laplace to Lockyer and Darwin, for the sole feature that potentially shaped the history of the earth was the early gaseo-molten state in which they essentially concurred. An alternative was, indeed, offered in the suggestion that the earth might have grown up by the accretion of small bodies, but it was then held by students of dynamics that such an origin was inconsistent with the symmetry of the system and the rotations of the planets, and so an origin in the gaseous or quasi-gaseous form was almost universally accepted, as by compulsion. Later, the gaseous earth, by cooling and condensing, was thought to pass into a molten sphere wrapped in a hot, vaporous atmosphere. This atmosphere was vast because the conditions required it to contain all the water of the globe and all the volatile matters that have since entered into the waters and the body of the earth. At a later stage a crust was logically made to form over the molten sphere, and the waters to condense upon it, swaddling the entire globe, perhaps, in a universal ocean. By further cooling, shrinkage, and deformation, the waters were thought to be drawn into basins, the land to appear, and the history of the stratigraphic record to begin. It is important to note that the main agency in this hypothetical history was loss of heat; and so, with consistent logic, loss of heat was made to lie at the bottom of the great events of the earth's subsequent history, and, in the forecast, to be the chief cause of its doom. From a plethora of heat, of air, and of ocean, putative loss followed loss in the past, and by prophecy loss is to follow loss in the future until emaciation, drought, and frigidity mark the final state and the end of all life.

As the body of the earth cooled and shrank and permitted penetration, the ocean was made to enter it, and, by union with its substance, was thought to have been suffering loss in the long past and to be doomed to further losses yet to come. By a like union of the constituents of the air with the body of the earth, as time went on, the great smothering atmosphere of the primitive days was supposed to be brought down first to compatibility with marine life, later to the lower land life, and still later to the higher air-breathing forms.

Projected logically into the future, still further depletion of the vital constituents, even to the verge of exhaustion, attended with pauperisation and finally with extinction of life, entered into the forecast. With the gathering of the oceans more and more into the basins, and their absorption into the body of the earth, with the persistent consumption of the atmosphere, and with the progressive cooling of the whole, the moisture of the air was thought also to have grown less and less. At first a deep, warm mantle of vapour and cloud hypothetically clothed the whole earth, and even half-way down the geologic ages was thought to have enshrouded the globe and to have given warm, sultry climates to all latitudes. But this mantle at length was made to give place to rifted clouds and clearer skies, and later on to mild aridities, followed at length by desert stages, which are even now supposed to be creeping out persistently on the once fertile lands. Thus we reach our own times at a putative stage when heat and air and moisture are running low; thus the predestined end is foreshadowed in the not distant future.

The round conception of the history shaped it as a progress from excess to emaciation, a sliding down the scale; it made the life-history but an episode intercurrent in the great decline from the too hot and the too much to the too cold and the too little.

The logic in all this is plausible. Starting with the hypothetical premises, the conclusions seem to follow. Variations of detail might well be found in the complexities of the case. Especially might sources of supply be assigned to offset waste and loss in some degree, but, granting the premises, the conclusion is not easily escaped. In point of fact, the general conception dominated the geologic thought of the last century. Not only this, but in no small degree it gave direction to the interpretations, and

[1] Address delivered at Boston, Mass., on December 27, 1909, by the retiring president of the American Association for the Advancement of Science, Prof. T. C. Chamberlin.

in some measure even influenced the observations of geologic phenomena well down to the close of the century, and is far from obsolete to-day.

But, logical and plausible as was this general conception of earth-history, it was hung, as you have not failed to notice, on the hypothesis of the genesis of the earth accepted. However logical, its logical strength was only that of the hypothesis on which it was hung. I say its *logical* strength advisedly, for outside the logic of the general concept there was always the appeal to the concrete evidences of the geologic record. This appeal was made, and was thought to be on the whole confirmatory. The strata of high latitudes were found to contain relics of life of tropical or subtropical types, not only in the early stages, but well down toward recent times. Figs and magnolias grew in Greenland as late as the Tertiary period. Phenomena so striking gave deep hold to the logical scheme. Phenomena not so consonant with it were easily overlooked or lightly passed by, as is our wont when too much impressed by what *must* be true. It is, however, a merit of modern science that it puts that which *is* to the front, and that which logically *must be* in a secondary place; and so, during the past century, inconsonant data were gathered with the consonant. Most of the inconsonant facts were of the unobtrusive sort, but yet some of them were startling, were seemingly incredible, were indeed long doubted, and only slowly gained credence. The accumulation of this inconsonant data gradually weakened the hold of the general logical concept and prepared the way for a reconsideration.

Meanwhile a serious source of doubt had arisen on the logical side, from the progress of physics. The older hypotheses of the origin of the earth had been framed before the kinetic theory of gases was evolved. After the kinetic view was accepted, it was pointed out by Johnstone Stoney that the velocities of the molecules of the outer air place a limit to the volumes which planetary atmospheres may possess. When the test which this suggested was applied to the postulated atmospheres and voluminous gaseous states of the early earth, it gave rise to grave doubt as to the physical consistency of these conceptions.

Weakness also arose in another quarter. One of the main props of the gaseous or quasi-gaseous hypotheses was, as already remarked, the general conviction, based on dynamical grounds, that condensation from any other nebulous state than the gaseous or quasi-gaseous would give revolutions and rotations to the planetary system at variance with those actually possessed. A re-examination, however, near the close of the century, developed grounds for the conviction that a gradual gathering in of matter from a scattered orbital state would give rotations and revolutions quite as well in accord with the facts formerly known, and seemingly even better in accord with new facts recently brought to light.

Thus toward the close of the last century there arose from different quarters cogent reasons for a reconsideration of the prevailing general view, and with it a recast of the former forecast. Further scrutiny added new doubts to those that had previously arisen, and in the end the verity of the older hypotheses of genesis was challenged, and new conceptions, based on orbital dynamics, in contrast to gaseous dynamics, were offered in their stead.

It is not appropriate for me to say that this challenge was successful, or that the older conceptions of the earth's origin are to be laid on the shelf. As an advocate of the method of multiple working hypotheses, it belongs to me to beg of you to save and to use, so far as you can find use in them, all the hypotheses that seem to you to be capable of working at all. Much less would it be appropriate for me to affirm that any form of the newer conceptions is entitled to take the place of the older in your complete confidence. The final adjudication of genetic hypotheses can only come of long and patient trial by searching analysis, by scrutinising logic, and by application to the multitudinous phenomena which the earth, not only, but the solar and stellar systems, present. It is sufficient warrant for the present review, however, that not a few of the more incisive students of these things have been led seriously to reconsider the foundations of the hypothesis of earth-genesis that have been offered, old and new, and to examine with renewed care the interpretations and inferences that have been made to hang upon them. Whatever may be your personal leanings, you will, no doubt, agree that it seems less laudable now to hang prophecies of the future upon hypotheses of genesis than when certain of these hypotheses received the almost universal assent of those then best qualified to hold opinions respecting them.

It does not seem to be going too far, moreover, to say that, whereas we seemed to be shut up to hypotheses of genesis that gave the earth a gaseo-molten state at the start, it now seems, to some students at least, possible that the earth inherited a quite different state from a slow growth from planetesimal or other accretions. If diverse views are thus permissible, they offer alternative working conceptions, and thus help to give freedom of interpretation while they stimulate observations on the critical phenomena. We may, therefore, be permitted first to review the states assigned the early earth by the competitive genesis offered, and then the critical phenomena that bear upon the earth's future.

Quite in contrast with the older pictures of a primitive earth cooling from a gaseous state, the planetesimal hypothesis, which may be taken as representative of theories based on concentration from a dispersed orbital state, postulates a solid earth growing up slowly by accessions, and becoming clothed gradually with an atmosphere and a hydrosphere. Each of the fundamental parts, the earth, the air, and the water, is made to grow up thus together from smaller to larger volumes without necessarily attaining at any stage a very high temperature. The early sources of growth for the atmosphere and the ocean, though reduced in later time, continued to serve as sources of replenishment when the familiar agencies of loss came into play in the later ages. Thus, far from assigning at the start a vast atmospheric and oceanic supply, and assuming progressive depletion of this with the progress of time, the newer view starts with a minimum supply and rests on means of feeding which are held to run hand in hand with the sources of loss and more or less completely to compensate them in a varying way. The question of the future under this view is, therefore, not how long beyond the present day will the original supply last, but rather how long will the oscillating compensation of loss and supply remain effective? Or, in other words, how long will the past degree of equilibrium between the opposing agencies keep the critical conditions within the limits required by life? This question turns us quite away from any serious dependence on the original states, and centres attention on the geologic record and on the potency of agencies still in action. Are the chief agencies which have controlled life conditions for tens of millions of years past still in good working order and likely to continue effective for a long era yet to come, or do they show clear signs of declining power portending an early failure? Let us enter a little closer into the consideration of the specific factors on which life depends, though time will not permit us to go far.

The pre-scientific fear that the end of life will come by cataclysm is not yet obsolete, nor is it theoretically impossible, but violent agencies are among the least to be feared. Life might, indeed, be imagined to be in jeopardy from volcanic and seismic convulsions, but they really offer no serious menace to life in general, and appear never to have done so in the known ages. The deadliness of these boisterous catastrophes impresses itself unduly on the emotions. The real peril, if peril there be, lies in the deadly unbalancing of agencies of the quiet sort.

The conditions essential to the maintenance of the habitability of the earth are many, but the more critical factors either lie in the atmosphere itself or are intimately associated with it. The point of keenest interest is the narrowness of range to which these mobile factors are confined. The several constituents of the atmosphere might each or all easily be too scant or too abundant. In a peculiar sense is this true of the carbon dioxide, which, though one of the least, is pre-eminently the decisive constituent of the atmosphere. A small proportion of carbon dioxide is essential to plant life, and so to animal life, while a large proportion would be fatal to air-breathing animals. If the three or four hundredths of one per cent. now present were lost, all life would go with it; if it were increased to a few per cent., the higher life would be suppressed or radically changed; and yet, on the one hand, the theoretical sources of supply are abundant, while,

on the other, the agencies of depletion are efficient and active. There is little escape from the conclusion that, ever since the birth of air-breathing life, some 30,000,000 or 40,000,000 years ago, let us say, the interplay of these agencies of supply and depletion has been so balanced that neither fatal excess nor fatal deficiency has been permitted to cut short the history of the higher life.

The dangers of excess or deficiency of the other constituents of the air are, indeed, less narrow when named in percentages, but they are scarcely less real in theoretical possibility.

The well-being of life is hemmed in between a suitable proportion of moisture in the air dependent on a competent area of water-surface to supply it, on the one hand, and a diluvial excess of water, on the other. Universal deluges and universal deserts would alike be disastrous. A few thousand feet more of water-depth or a few thousand feet less would alike seriously restrict the class of life to which we belong.

In even a more serious way the habitability of the earth is conditioned on a narrow range of mean temperature—a range, roundly speaking, of 100° Centigrade. This is scarcely 5 per cent. of the range of natural temperatures on the earth, and a still smaller per cent. of the range of temperatures in the heavens. A few miles above us and a few miles below us fatal temperatures prevail. It is profoundly significant that the thermal states of the narrow zone of life on the face of the earth should have been kept within so close variations as to permit the millions of species forming the great genealogical lines leading up from the primitive types to have perpetuated their lineages in unbroken continuity for such ages, while the prevalent temperatures a few miles above them or a few miles below them, as well as in space generally, would have been fatal. While the necessary heat is dependent on the sun, this control of temperature seems to have been intimately related to the atmosphere, and is a further index of its specially critical functions.

To appreciate the full significance of the control of life conditions within these narrow limits when the possibilities were so free and so wide, there is need for some tangible index of the time, but there are at present no means for the close measure of the geologic ages, merely rough estimates of the order of magnitude. Life was far advanced when a readable record first began to be made; but yet, since that record began, at least 100,000 feet of sediments—not to choose the largest estimates—have been laid down by the slow methods of wash from the land and lodgment in the basins. The estimate of the years thus represented has been put variously from 50,000,000 to 100,000,000, with, indeed, higher figures as well as lower. Merely to scale roughly the order of magnitude, and without pretence of accuracy, let us take the midway figure of 75,000,000 years as representative. Let this be divided into fifteen periods of 5,000,000 years each, and these will roughly represent the technical "periods" of geologists. By this rough scale we may space out such of the great events as we need now note.

Slight and changeable excesses of evaporation over precipitation and the reverse prevail widely, but only intense and persistent aridity gives rise to thick deposits of salt, gypsum, and other evaporation products over large areas—with perhaps some exceptions—for in nearly all large natural basins the area that collects rainfall is notably larger than the closed basin within it that alone can retain water for continuous evaporation. It is, therefore, fairly safe to infer clear skies and pronounced aridity when beds of salt and gypsum occur over large areas, especially if accompanied by appropriate physical characters and by such types of life only as tolerate high salinity or show pauperisation, or by a total absence of life.

Now extensive deposits of salt and gypsum are found in the Salt Range of India, in strata of the Cambrian period, the earliest of the fifteen that make up our rough scale of 75,000,000 years. Because these lie so near the beginning of the geologic record, they afford a singularly instructive insight into the conditions of the atmosphere well back toward its primitive state. They challenge at once the view that in those early ages the earth was swaddled by a dense vaporous atmosphere from pole to pole; for under such a vaporous mantle a great desert tract in India would be scarcely credible.

If we come forward in time two periods, to the deposits of the Silurian stage, we find that, underlying the basin of the St. Lawrence in New York and westward, there stretch great sheets of salt and gypsum, many thousand square miles in extent. These beds are accompanied by complete barrenness of life in some parts, by pauperisation of life in other parts, by selections of life according to tolerance of salinity in still other parts, and by harmonious physical characters, all of which combine to add strength to the interpretation. All these imply a degree of aridity approaching desert conditions in what is now the well-watered region of our Great Lakes. These signal facts join those of the Salt Range of India of earlier date in challenging the former conception of a universal envelope of vapour and cloud in all those early times.

In the next period there are formations that have been interpreted as implying desert conditions, but perhaps on less firm grounds, and we pass on to certain stages in the Sub-Carboniferous period next following, wherein beds of salt and gypsum are found in Montana, Michigan, Nova Scotia, and Australia, which imply like climatic conditions. If we pass on to the Permian and Triassic periods, near the middle of the geologic series, beds of salt and gypsum are phenomenally prevalent on both the eastern and western continents, reaching through surprising ranges of latitude. The relative paucity, as well as the peculiar characteristics of the life of those times, seems equally to imply vicissitudes of climate in which scant atmospheric moisture was a dominant feature. There seems no tenable way to interpret these remarkable facts of the middle periods except by assuming an even greater prevalence of aridity than obtains at the present time. So, at times in the later periods, but at times only, the stratigraphic record implies atmospheres as arid as that of to-day, not everywhere, indeed, but in notable areas and in certain horizons.

These and other significant facts of consonant import form one group of phenomena.

If, on the other hand, the record be searched for facts of opposite import, they will come easily to hand. Starting near the beginning of the record, it is even more easy to find stages abounding in evidences of prevailing humidity, of great uniformity of climate, and of most congenial life-conditions reaching through wide ranges of latitude. If we rested on this selection alone, the old view would be abundantly sustained, but the strata bearing evidences of aridity lie between these. Combining the two sets of facts, the conception seems to force itself upon us that from the very earliest stages of the distinct life-record onward, there have been times and places of pronounced aridity much as now, or even more intense, while at other times, intervening between these, more humid and uniform conditions prevailed.

This conception grows in strength as we turn from atmospheric states to prevailing temperatures. The body of scientific men have rarely been more reluctant to accept any interpretation of geologic phenomena than that of recent general glaciation on the lowlands of Europe and America in mid-latitudes when that view was first advanced by Louis Agassiz. With the conception of former pervasive warmth then prevalent, it seemed beyond belief that great sheets of ice could have crept over large portions of the habitable parts of Europe and North America some thousands or tens of thousands of years ago. Belief in this was made easier, however, by the view also then prevalent that the earth had been greatly cooled in the progress of the ages, that the atmosphere had been much depleted by the formation of coal, of carbonates, and of oxides, that the ocean had been reduced by hydration and entrance into the earth, and that thus a stage had been reached that made possible an epoch of depressed temperature and of glaciation. The Ice age, thus theoretically associated, came to be widely regarded as but the first stage in a series of secular winters destined to lead on to the total refrigeration of the earth. This view was abetted by the theory of a cooling sun. The depleting and the cooling processes were regarded as inevitably progressive, and the final doom of the earth as thus foreshadowed in the near future, geologically speaking.

But opinion was scarcely more than adjusted to this view when the geologists of Australia, of India, and of South Africa, severally and independently, and later those of South America, presented evidences of former glaciation

over extensive areas in those low latitudes. The typical marks of glaciation were, indeed, traced even up to and a little across the tropical circles from the south, in Australia, and from the north, in India. Moreover, all these were reported from strata of Permian or late Carboniferous times, *i.e.* from the sixth or seventh of the technical "periods." For a score of years the body of geologists, not in immediate contact with the evidence itself, doubted the interpretation, but the growing evidence grew at length to be utterly irrefutable. There seems no rational escape from the conclusion that mantles of ice covered large areas in the peninsula of India, in Australia, in the southern part of Africa, and in South America, close upon the borders of the tropics, at a time roundly half-way back to the beginning of the readable record of life.

On the basis of similar evidence, Strahan and Reusch have announced glacial beds in Norway at a horizon much lower but not closely determinate. Willis and Blackwelder have described glacial deposits of early Cambrian age in the valley of the Yangtse, in China, in latitudes so low as 31°. Howchin and David have described glacial formations of similar age in Australia. In the last two cases the glacial beds lie below the strata that bear the Cambrian trilobites; in other words, they lie at the very bottom of the fossil-bearing sediments, fifteen periods back, or 75,000,000 years ago on our rough scale. Prof. Coleman has offered what he deems good evidence of glaciation much farther back at the base of the Huronian, in Canada, but some scepticism as to its verity has yet to be overcome.[1]

Even more pointedly than the epochs of aridity do these early epochs of glaciation seem incompatible with the view of a hot earth universally wrapped in a vaporous mantle in early times. They favour the alternative view of merely temporary localised intensifications of climate which life was able repeatedly to survive. This seems to warrant the belief that life may survive similar intensifications again and again in the future.

At present polar and alpine glaciation are contemporaneous with aridity. There are reasons for thinking that the past glaciations and aridities were in some similar way correlated, and that they cooperated to give vicissitude to the climates of certain geologic epochs. The known epochs of glaciation, however, are fewer than those of aridity.

On the other hand, at several stages, as already noted, abundant life, bearing all the evidences of a warm-temperate or subtropical character, flourished in high latitudes. In Greenland, Spitsbergen, and other Arctic islands, are found the relics of life not known to be able to live except under conditions of genial warmth. These imply former subtropical conditions where now only frigidity reigns.

In the light of these contrasted climatic states of aridity and glaciation on the one hand, and of uniformity and geniality in high latitudes on the other, intervening between one another, we seem now forced to the conception of profound climatic alternations, extending over the whole stretch of known geologic time. Concurrent with these alternations, there may, perhaps, have been variations in the constitution, as there certainly were in the condition, of the atmosphere.

If we turn to the relations of the waters and the land, an analogous oscillating history presents itself. This was possibly connected causally with the climatic oscillations. At no time in the history recorded by clear geologic testimony is there proof of the absence of land, and certainly at no time is there a hint of the absence of an ocean, whatever theoretic views may be held of the earliest unknown stages.

The progress of inquiry seems to force the conviction that the land area in the earliest stages of good record was quite comparable to that of the present time, both in its extent and in its limitations. Following down the history, the land area seems at certain times to have been larger than now, while at other times it was smaller. There appears to have been an unceasing contest between the agencies that made for the extension of the land and the agencies that made for the extension of the sea. While each gained temporarily on the other, complete victory never rested with either. From near the beginning of the readable record there appears to have been an unbroken continuity of land life, and, from a like early stage, an unbroken continuity of marine life. Probably the history of both goes back unbroken into the undeciphered eras which precede the readable record, and no one to-day can safely affirm the precedence of either over the other, either in time or in genesis, whatever his theoretic leanings may be.

Among the agencies that may be assigned for the extension of the land are those that deform the body of the earth, deepening its basins and drawing off the waters, while other portions are protruded and give renewed relief and extent to the land. Among the agencies that make for the extension of the sea are the girdling of the waves about the borders of the land, and the decay and wash of land surface, which is thus brought low at length and covered by the advancing waters. If the deformation of the earth-body were held in abeyance for an indefinite time, the lowering of the land, the filling of the basins, and the spreading of the sea would submerge the entire land surface and bring an end to all land life. Great progress in such sea-transgressions appears to have been made again and again, until perhaps half the land was submerged, but before land life was entirely cut off, or even very seriously threatened, a regenerative movement in the body of the earth intervened, the land was again extended, and the sea again restricted. Here then, also, there has been a reciprocal movement, which, while it has brought alternate expansions of land life and of sea life, has, notwithstanding, permitted the preservation of both, and thus maintained the continuity of the two great divisions of life.

It appears, thus, that in each of the great groups of terrestrial conditions upon which life is dependent, there has been, through the known ages, vast as they are, an oscillatory movement which has brought profound changes again and again, but has never permitted any of the disasters threatened in these movements to go far enough to compass the universal extinction of life. These reciprocal movements appear to be dependent upon a balancing of the action of agencies that is scarcely less than a law of equilibrium. It is not too much to regard this as a regulative system. A clear insight into the agencies of this regulative system is rather a task of the future than an attainment of the present, and I can only offer tentative hints of what may prove to be its main factors, and beg of you to accept them with due reserve.

The preservation of the land against the incessant encroachments of the waters seems probably due to a periodic deformation of the earth-body dependent on internal dynamics not yet well understood, at least not yet demonstrated to general satisfaction. The body of the earth feeds its atmosphere through volcanic and other means. How far this is merely a return of what has been absorbed earlier it is not prudent here to say, as opinion is not harmonious on this, and the evidence is as yet uncertain. Much depends on the constitution of the earth's interior, and that in turn hinges on its mode of origin. Perhaps it will be agreed generally that feeding from the interior is one of the sources of supply which offsets the depletion of the atmosphere caused by its union with earth substance, in short, that the earth-body gives out as well as takes in atmospheric material. Important or unimportant as this may be, it is not apparent that there is in it any automatic balancing suited to control the delicate adjustments requisite for continuity of life. The ocean acts as an important regulator by alternately absorbing and giving out the atmospheric gases as required by the state of equilibrium between the water and the air. This action is automatic, but has its limitations and peculiarities, and does not seem wholly adequate. If we are able to name such an adequate automatic action at all at present, it probably lies in the molecular activities of the terrestrial and solar atmospheres, and in the relations of these to the gravitative powers of the earth and the sun.

If analysis of the molecular action of the outer atmosphere be pushed to its logical conclusions, it leads to the conception of supplementary atmospheres, in part orbital, filling, in an attenuated way, the whole sphere of the earth's gravitative control. A similar study of the sun's atmosphere suggests a similar supplementary extension, and this extended portion surrounds and embraces the earth's

[1] Later evidence has removed this from many minds, including that of the speaker.

atmosphere. Under the laws of molecular activity these two atmospheres must be interchanging molecules at rates dependent on the conditions of equilibrium between them. It is reasonable that an excess in the earth's atmosphere should cause it to feed out into the sun's sphere of control more than it receives, and that a deficiency in the earth's atmosphere should cause more feeding in from the sun's supplementary atmospheres than the earth gives out. If this conception be true and be efficient, the maintenance of the delicate atmospheric conditions required for the continuity of life is automatically secured.. The failure of our atmospheric supply is thus made to hang, not simply on the losses and gains at the earth's surface, but on the solar interchange, and hence on the solar endurance.

The sun is giving forth daily prodigious measures of energy. The endurance of the sun is not, however, merely a question of unrequited loss, for it gains energy and substance daily as well as loses, and, so far as present knowledge goes, its gain is greatly inferior to its loss. So long as the heat of the sun was supposed to be dependent on ordinary chemical changes, or on the fall of meteorites, or on self-contraction, an activity adequate for terrestrial life could only be estimated at a few million years. But recent discoveries in radio-activity have revealed sources of energy of an extremely high order. In the light of these the forecast of the sun's power to energise the activities of the atmosphere dependent on it, and to warm the earth, is raised to an indeterminate order of magnitude.

If we may thus find grounds for a complacent forecast in reciprocal actions on the earth and in reciprocities between the earth and the sun, are we free from impending dangers in the heavens without?

Present knowledge points to one tangible possibility of disaster—collision with some celestial body, or close approach to some sun or other great mass, large enough to bring disaster by its disturbing or disruptive effects. Within the solar system, the harmonies of movement already established are such as to give assurance against mutual disaster for incalculable ages. Comets pursue courses that might, theoretically at least, bring about collision, but do not appear usually to possess masses sufficient to work complete disaster to the life of the earth even should collision occur, whatever local disaster might follow at the point of impact. The motions of the stars, however, lie in diverse directions, and collisions and close approaches between them are theoretically possible, if not probable, or even inevitable. There are also in the heavens nebulæ and other forms of scattered matter, and doubtless also dark bodies, which may likewise offer possibilities of collision. The appearance of new stars flashing out suddenly and then gradually dying away suggests the actual occurrence of such events. It has been even conceived that the close approach of suns is one of the regenerative processes by which old planetary systems are dispersed and new systems are brought into being. One phase of the planetesimal hypothesis is built on this conception, and postulates the close approach of some massive body to our ancestral sun as the source of dispersion of a possible older planetary system, and the generation of the nebulous orbital conditions out of which our present system grew. However this may be, it must be conceded that in collision and close approach lie possibilities, if not probabilities, of ultimate disaster to the solar system and to our earth. But here, as before, the vital question lies in the time element. How imminent is this liability? The distances between stars are so enormous that, though they move diversely, the contingencies of collision or disastrous approach are remote. Nothing but rough computations based on assumptions can be made, but these make disaster to a given sun or system fall, on the average, only once in billions of years. There is no star the nearness of which to us, or the direction of motion of which is such as to threaten the earth at any specific period in the future. There is only the general theoretical possibility or probability. While, therefore, there is to be, with little doubt, an end to the earth as a planet, and while, perhaps, previous to that end conditions inhospitable to life may be reached, the forecast of these contingencies places the event in the indeterminate future. The geologic analogies give fair grounds for anticipating conditions congenial to life for millions or tens of millions of years to come, not to urge the even larger possibilities.

But congeniality of conditions does not ensure actual realisation. There arise at once questions of biological adaptation, of vital tenacity, and of purposeful action. Appeal to the record of the animal races reveals in some cases a marvellous endurance, in others the briefest of records, while the majority fell between the extremes. Many families persisted for millions of years. A long career for man may not, therefore, be denied on historical grounds, neither can it be assured; it is an individual race problem; it is a special case f the problem of the races in the largest sense of the phrase.

But into the problem of human endurance two new factors have entered, the power of definite moral purpose and the resources of research. No previous race has shown clear evidence that it was guided by moral purpose in seeking distant ends. In man such moral purpose has risen to distinctness. As it grows, beyond question it will count in the perpetuity of the race. No doubt it will come to weigh more and more as the resources of destructive pleasure, on the one hand, and of altruistic rectitude, on the other, are increased by human ingenuity. It will become more critical as the growing multiplicity of the race brings upon it, in increasing stress, the distinctive humanistic phases of the struggle for existence now dimly foreshadowed. It will, beyond question, be more fully realised as the survival of the fittest shall render its verdict on what is good and what is evil in this realm of the moral world.

But, to be most efficient, moral purpose needs to be conjoined with the highest intelligence, and herein lies the function of research. None of the earlier races made systematic inquiry into the conditions of life, and sought thereby to extend their careers. What can research do for the extension of the career of man? We are witnesses of what it is beginning to do in rendering the forces of nature subservient to man's control and in giving him command over the maladies of which he has long been the victim. Can it master the secrets of vital endurance, the mysteries of heredity, and all the fundamental physiological processes that condition the longevity of the race? The answer must be left to the future, but I take no risk in affirming that when ethics and research join hands in a broad and earnest endeavour to compass the highest development and the greatest longevity of the race, the era of humanity will really have begun.

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MISCELLANEOUS.

D. Appleton and Co.—Psychology and the Teacher, Prof. H. Munsterberg. *E. Arnold.*—Book-keeping and Accounting, M. W. Jenkinson. *Chatto and Windus.*—A History of Babylonia and Assyria from Prehistoric Times to the Persian Conquest, L. W. King, illustrated; vol. i., A History of Sumer and Akkad: an Account of the Early Races of Babylonia from Prehistoric Times to about B.C. 2000; vol. ii., History of Babylon from the Foundation of the Monarchy, about B.C. 2000, until the Conquest of Babylon by Cyrus, B.C. 539; vol. iii., A History of Assyria from the Earliest Period until the Fall of Nineveh before

the Medes, B.C. 606. *The Gresham Publishing Company.*—Science in Modern Life, vols. v. and vi., illustrated. *C. Griffin and Co., Ltd.*—Modern Methods of Sewage Disposal, G. B. Kershaw, illustrated; Introduction to the Theory of Statistics, G. U. Yule, with diagrams. *Crosby Lockwood and Son.*—The Valuation of Mineral Properties, T. A. O'Donahue. *Longmans and Co.*—A History of the Cavendish Laboratory, Cambridge. This volume is intended to commemorate the twenty-fifth anniversary of the election of Sir J. J. Thomson to the Cavendish professorship of experimental physics. Among the contributors are the President of Queens' College, Dr. Schuster, W. C. D. Whetham, Dr. R. T. Glazebrook, Sir J. J. Thomson, Prof. H. F. Newall, Norman Campbell, Prof. E. Rutherford, C. T. R. Wilson, and Prof. Wilberforce. The final chapter of the book will be devoted to a bibliography and biography of those who have done research work at the laboratory since its foundation. *Macmillan and Co., Ltd.*—Tennyson as a Student and Poet of Nature, Sir Norman Lockyer, K.C.B., F.R.S., and Winifred L. Lockyer. *Oxford University Press.*—Chinese Pottery and Porcelain, a translation of the Tao Shuo, with introduction, &c., by S. W. Bushell. *G. Routledge and Sons, Ltd.*—Sonnenschein's Best Books, new edition, in three parts. *Swan Sonnenschein and Co., Ltd.*—Hegel's Phenomenology of Mind, translated by J. B. Baillie, 2 vols.; Thought and Things: a Study of the Development and Meaning of Thought or Genetic Logic, Prof. J. M. Baldwin, in 3 vols., vol. iii., Real Logic; Time and Free Will: an Essay on the Immediate Data of Consciousness, Prof. Bergson, translated by F. L. Pogson; Physiological Psychology, Prof. W. Wundt, a translation of the fifth and wholly re-written German edition by Prof. E. B. Titchener, in 3 vols., vol. ii. *Truslove and Hanson, Ltd.*—Oriental Silverwork, H. Ling Roth, illustrated. *The University Tutorial Press, Ltd.*—Hygiene for Training Colleges, Dr. R. A. Lyster.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Huxley lecture this year is to be delivered by Prof. Percy Gardner, Lincoln and Merton professor of classical archæology in the University of Oxford.

Mr. Joseph Coates has been appointed to a demonstratorship in chemistry, and Mr. R. H. Whitehouse assistant, in the Day Training College for Men.

CAMBRIDGE.—The next combined examination for sixty-seven entrance scholarships and a large number of exhibitions at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 6, and following days. Mathematics, classics, and natural sciences will be the subjects of examination at all the above-mentioned colleges. Most of the colleges allow candidates who intend to study mechanical sciences to compete for scholarships and exhibitions by taking the papers set in mathematics or natural sciences. A candidate for a scholarship or exhibition at any of the seven colleges must not be more than nineteen years of age on October 1, 1910. Forms of application for admission to the examination at the respective colleges may be obtained as follows:—Pembroke College, W. S. Hadley; Gonville and Caius College, the Master; King's College, W. H. Macaulay; Jesus College, A. Gray; Christ's College, Rev. J. W. Cartmell; St. John's College, the Master; Emmanuel College, the Master, from any of whom further information respecting the scholarships and other matters connected with the several colleges may be obtained.

OXFORD.—The University Junior Scientific Club will hold its triennial conversazione on Tuesday, May 24, being the Tuesday in "Eights Week." Members of the club can obtain tickets on application to Mr. N. T. Huxley, Balliol College. The promise of exhibits from members will be gratefully welcomed by Mr. A. F. Coventry, Magdalen College, on behalf of the committee. It is hoped that many old members of the club will take the opportunity of re-visiting the scientific departments of the University.

THE late Mr. E. S. Massey, of Rochdale, among many other bequests, has left 6800*l.*, free of duty, to the University of Manchester. The residue of his property, amounting to about 110,000*l.*, after the bequests are provided for, is left upon trust to be applied for such charitable purposes for the benefit of the inhabitants of Burnley as the Corporation of Burnley shall determine, but so that such purposes be limited to all or one or more of the following objects, and be not by way of reduction of rates:—education, whether mental, physical, technical, or artistic, the advancement of science, learning, music, or other art.

AN effort is being made to found a National Industrial Education League to emphasise the necessity of making elementary education go hand in hand with industrial training. In view of the general consensus of opinion as to the necessity for the formation of such a league, a national conference is to be called at an early date for the purpose of formulating a scheme for carrying out the objects of the league. In addition to the approval of many other associations of workers, no fewer than 88 trades' councils, together representing 334 towns and 299 trades, have given their adhesion, and the London Chamber of Commerce recently passed unanimously the following resolution:—"That the council of the chamber approve, heartily support, and will give all their assistance to the proposed National Industrial Education League." Anyone anxious to take part in the work of the new league should communicate with Mr. R. Applegarth, Central Offices, Craig's Court House, Charing Cross, London.

MR. W. H. LEVER, who was appointed recently chairman of the Liverpool School of Tropical Medicine, in succession to the late Sir Alfred Jones, has made known to the council and professors of the University of Liverpool the particulars of a munificent scheme he has devised to assist the work of the University. He proposes to devote the sum of 91,000*l.* to the scheme. Arrangements have been made with the owners of the old Bluecoat School for a lease for a number of years. During that period the University can have the option of purchasing the school for a sum, approximately, of 24,000*l.* Any time when the University exercises that option Mr. Lever will pay the money, and the school will be furnished. If the building is not found suitable, then he will pay 24,000*l.* for the erection of a building adjoining the University, in which the School of House and Town Planning can be accommodated, and also the School of Architecture. While the University is considering whether the option shall be exercised, Mr. Lever will pay the rent of the school. To provide money for the School of House and Town Planning, the School of Tropical Medicine, and the School of Russian Studies, Mr. Lever proposes to transfer 60,000*l.* worth of shares in the Bromboro' Port Estate Company to the University. These shares will in future years be a source of great income to the University. While the shares are not paying a dividend, Mr. Lever has arranged for ten years to guarantee 3 per cent. on the 60,000*l.*, which will make 1800*l.* a year for ten years. With the consent of the University, of this 1800*l.* a year 800*l.* will go to the School of Civic Design, 800*l.* to the School of Tropical Medicine, and 200*l.* to the School of Russian Studies.

ON Friday last, March 4, the Chancellor of the Exchequer, with whom were Mr. Haldane and Mr. Runciman, received in his private room at the House of Commons a deputation from various universities on the subject of increased financial assistance. A news agency states that the deputation represented all the universities and university colleges in England, excepting Oxford, Cambridge, and Durham. The proceedings were private, but the *Times* gives the following account of the points brought forward by the deputation. It was urged that money is greatly needed for development purposes. The Treasury grants, so far from cutting off local subscriptions, municipal and private, have encouraged them, local people feeling that the institutions are recognised by the Government and regarded as a national concern to which they may well contribute. Every new chair established and every new building put up means extra expense for maintenance, and the deputation urged that, while it is quite possible to get the locality to provide buildings and equipment, it cannot

provide maintenance. Many localities feel they have done all they can, and they also feel they are not merely doing local work, but national and Imperial, indeed, world-wide work. Students are drawn from every part of the Empire and from foreign countries, particularly China and Japan, and they are under no obligation to give their services where they are trained. Any increased grant now given by the nation will be used, not in the fixed and ordinary work of the institutions, but in the highest class of work and in various enterprises that are being kept back for want of funds. The speakers also pointed out that there is under present conditions a certain amount of wastefulness, not in money, but in brains and energy, because at their meetings the authorities are generally occupied, not in discussing how best to spend the money and what undertakings will be best for the country, but merely how to economise their funds and how to save 10*l.* or 50*l.* Work is lying ready at hand which they are powerless to undertake. Mr. Lloyd George, in the course of a sympathetic reply, told the deputation they could not have come at a worse time. Nothing definite was settled, but a committee has been appointed by the deputation to prepare more detailed information for the Chancellor of the Exchequer as to the financial requirements of the various institutions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 27.—Sir James **Dewar**: Long-period determination of the rate of production of helium from radium. In a previous communication the rate of the production of helium from 70 milligrams of radium chloride was determined by a succession of observations on the growth of pressure measured by a McLeod gauge. These observations extended over a period of about six weeks. It was thought desirable to make an experiment to determine the amount of helium resulting from this same sample of radium, after standing in a sealed bulb for an extended period. For this purpose the bulb containing the radium chloride was sealed off at the conclusion of the above-mentioned experiment of 1908 and kept for nine months. In order to measure the helium thus produced it was necessary to devise a vacuum-tight joint between the sealed radium bulb and a McLeod gauge so constructed that, after thoroughly exhausting the gauge, the drawn-out end of the radium bulb could be broken off, thus allowing the pressure of the accumulated helium in the radium bulb to be rapidly determined. The total volume of the apparatus was 320 c.c. The pressure in the radium bulb when sealed off at the conclusion of first experiment was 0·00406 mm., the partial pressure due to this amount of helium would be 0·00008 mm., which must be deducted from the observed pressure to get the true pressure due to the helium produced in the radium bulb during the period in which it remained sealed up; also the pressure in the gauge, before breaking (0·00005 mm.), must also be deducted. This gives a corrected pressure of 0·01613 mm., obtained after heating the salt, due to the helium produced from 70 milligrams of pure radium chloride during a period of 275 days, in a space the total volume of which was 320 c.c. The value of the rate in terms of cubic millimetres of helium per gram of radium per day is thus deduced as 0·463.

March 3.—Sir Archibald Geikie, K.C.B., president, in the chair.—T. G. **Bedford**: The depression of freezing point in very dilute aqueous solutions.—J. **Mercer**: Sturm-Liouville series of normal functions in the theory of integral equations. It is the purpose of this memoir to develop the theory of Sturm-Liouville series of normal functions as a branch of the theory of integral equations. In the first place, two theorems are established relative to the series

$$\psi_1(s)\int_a^b \psi_1(t)f(t)dt+\psi_2(s)\int_a^b \psi_2(t)f(t)dt+\ \dots$$
$$\dots\ +\psi_n(s)\int_a^b \psi_n(t)f(t)dt+\ \dots,$$

in which $\psi_1(s), \psi_2(s), \dots, \psi_n(s), \dots$ are a complete system of normal functions corresponding to a function ($K(s, t)$) of positive type in the square Q defined by $a\leq s\leq b$, $a\leq t\leq b$: the normal functions are assumed to have such an order that the singular value corresponding to $\psi_n(s)$ does not decrease as n increases: no restriction is placed upon $f(s)$ beyond that it should have a Lebesgue integral in (a, b). Denoting by $K_\lambda(s, t)$ the solving function corresponding to $K(s, t)$, the first theorem is to the effect that the upper and lower limits of indeterminacy of the above series include

$$\overline{\underline{\lim}}_{\lambda\to-\infty} -\lambda\int_a^b K_\lambda(s, t)f(t)dt$$

between them. According to the second

$$\lim_{\lambda\to-\infty} -\lambda\int_{(Q)} K_\lambda(s, t)f(s)f(t)\,(ds\,dt)$$

exists and is equal to the sum of the series

$$\left[\int_a^b \psi_1(t)f(t)dt\right]^2+\left[\int_a^b \psi_2(t)f(t)dt\right]^2+\ \dots$$
$$\dots\ +\left[\int_a^b \psi_n(t)f(t)dt\right]^2+\ \dots,$$

when the latter is convergent; whilst the limit is $+\infty$, when the series is divergent. It is then shown that, when $K(s, t)$ is the Green's function of

$$\frac{d^2u}{ds^2}+q(s)u=0$$

satisfying a pair of boundary conditions at the end points of $(0, \pi)$, an asymptotic formula for $K_\lambda(s, t)$ exists which permits the deduction of important theorems relative to the canonical Sturm-Liouville series

$$\psi_1(s)\int_0^\pi \psi_1(t)f(t)dt+\psi_2(s)\int_0^\pi \psi_2(t)f(t)dt+\ \dots$$
$$\dots\ +\psi_n(s)\int_0^\pi \psi_n(t)f(t)dt+\ \dots$$

The normal functions $\psi_1(s), \psi_2(s), \dots, \psi_n(s), \dots$ are now solutions of

$$\frac{d^2u}{ds^2}+(q(s)+\lambda)u=0,$$

which, for suitable values of λ, satisfy the same pair of boundary conditions as $K(s, t)$; to particular systems of these functions correspond Fourier's sine and cosine series. The results obtained for *any* canonical Sturm-Liouville series are very similar to, but slightly more general than, those for the two *particular* series which are associated with the names of Fejér, Hurwitz, and Lebesgue. The fourth section of the memoir is devoted to an investigation of the convergence of canonical Sturm-Liouville series. In the course of this, it is shown that the convergence of any one of these series at a point of the open interval $(0, \pi)$ involves the convergence of all the other series which correspond to the same function $f(s)$. The memoir contains an extension of all results obtained for the canonical to the most general type of Sturm-Liouville series.—A. **Von Antropoff**: The solubility of xenon, krypton, argon, neon, and helium in water.—L. N. G. **Filon**: Measurements of the absolute indices of refraction in strained glass. If light be transmitted through a slab of glass under tension T in a direction perpendicular to the line of stress, it is broken up into two components, polarised in planes perpendicular and parallel to the line of stress. If μ be the index of refraction of the glass in the unstrained state, then, in the strained state, the indices of refraction corresponding to the above two components are $\mu+C_1T$, $\mu+C_2T$ respectively. The coefficients C_1, C_2 are spoken of as the stress-optical coefficients for the two rays. The present paper gives an account of measurements of C_1 and C_2 according to a method described by the author in Roy. Soc. Proc., A, vol. lxxix., pp. 440–2. The measurements have been carried out on two Jena glasses bearing catalogue Nos. O. 935 and VV. 3199 respectively, the first being a borosilicate, the second an "ultra-violet" glass. So far as is known, this is the first series of absolute measurements of C_1 and C_2 extending fairly continuously throughout the spectrum. The only previous measurements are due to Pockel (*Ann. d. Phys.*, 1902), and give the

ues of C_1 and C_2 for the sodium, thallium, and lithium es only, obtained by quite a different method. The fficients C_1, C_2 are found to be negative, so that both s are accelerated by tension, but the effect is much ger for C_2, *i.e.* for the ray polarised in the direction of ess. With regard to the dispersion in O. 935, both C_1 l C_2 show a slight general decrease as we move towards violet, but in VV. 3199, C_1 shows a decrease, whereas shows an increase. The above general variation is ken by a number of local oscillations, some of which well marked and confirm previous observations of $-C_2$} (Phil. Trans., A, vol. ccvii., pp. 293–301), whilst ers are more doubtful; but it seems probable that both ices of refraction due to stress are affected locally by e periods of the constituents of the glass, causing egularities in the curves of C_1 and C_2 similar to those ibited by the curve of the index of refraction in malous dispersion.

Royal Microscopical Society, February 16.—Prof. J. A. omson, president, in the chair.—Prof. J. A. **Thomson**: tes on *Dendrobrachia fallax*, a rare and divergent anti-harian.—A. A. C. E. **Merlin**: The measurement of the t nine groups of Grayson's finest twelve-band plate.— H. **Collins**: The labelling of microscopic slides.

CAMBRIDGE.

Philosophical Society, February 7.—Prof. W. Bateson, R.S., president, in the chair.—E. A. Newell **Arber**: note on some fossil plants from Newfoundland. Two v records from Newfoundland, either of Lower rboniferous or Upper Devonian age. The first appears be *Sphenophyllum tenerrimum*, Stur., both leaf whorls l stems being preserved. The second is a large fan-ped leaf, probably new specifically, which recalls the læozoic fossils attributed to the genus Psygmophyllum. V. T. **Gordon**: The relation between the fossil mundaceæ and the Zygopterideæ. The members of the gopterideæ and Osmundaceæ are shown to exhibit allel development, and their most primitive genera, *gopteris Römeri*, Solms, and *Thamnopteris Schlechtenii*, Eichwald, respectively, are compared as regards the ucture of the stem and the origin of the petiole to nonstrate an ancestral relationship between these groups. V. T. **Gordon**: A new species of Physostoma from the wer Carboniferous of Pettycur (Fife). A new seed, wing a number of tentacular processes at the apex and outer coat studded with small peg-like hairs. This is most ancient example of the genus known.—Mrs. E. A. well **Arber**: A note on *Cardiocarpon compressum*, ll. The results of a re-examination of a Coal-measure d originally figured and described by Williamson in 7 under the name of *Cardiocarpon compressum*.— Hamshaw **Thomas**: The assimilating tissues of certain al-measure plants. Some points in the structure of the ves of Calamites, Lepidophloios, and other Coal-measure nts from the point of view of their physiological atomy.—L. J. **Wills**: Notes on the genus Schizoneura, imper and Mougeot. A description of examples of *izoneura paradoxa*, S. and M., recently discovered in Keuper of Bromsgrove (Worcestershire), and a com-ative review of other members of the genus.—R. D. **rnon**: The occurrence of *Schizoneura paradoxa*, S. and in the Bunter of Nottingham.—D. G. **Lillie**: rified plant remains from the Upper Coal-measures of stol. Petrified material of Cordaites and other allied era, and also of Myeloxylon, has been obtained from Upper Coal-measures of Staple Hill, Bristol.

MANCHESTER.

Literary and Philosophical Society, January 25.— Francis Jones, president, in the chair.—Prof. W. W. H. and F. **Brotherton**: The electrical resistance of the nan body. Measurements have been made with direct alternating currents, the hands of the subject being as ule immersed in solutions of common salt. Values of resistance in the first case are from 1000–2000 ohms, only from 700–800 ohms with alternating currents. The h values in the first case are due to polarisation, the nan body acting like a storage battery made up of con-tration cells. When a direct current is applied to the y the current falls for a time and then increases, there being a gradual increase of polarisation during the first period, and a decrease of the body resistance during the second period. The maximum voltage for direct currents used in the experiments was about 40, which mut be gradually introduced, and very gradually withdrawn, otherwise painful shocks are administered. It was found that the resistance is inversely proportional to the area of the surface of the wet skin. The ratio of the direct to the alternating values of the resistance is much higher when dry or nearly dry skin is tested. With the dry fingers applied to 100-volt direct current terminals the shock at the kathode is greater than at the anode, and enables the polarity of the terminals to be readily determined. With nearly dry fingers it is also easy to test polarities of circuits of less than 20 volts. This method is useful in practice. With about 10 volts and the fingers immersed in salt solutions containing metal electrodes, the body can be used as a telegraphic receiving instrument, the shocks at the kathode as the current is reversed by a transmitting commutator enabling messages to be received by the usual code. The resistance of the body being relatively low when the skin is moist, precautions must be taken in using supply circuits, especially in chemical and other works. Electric-light fittings in bathrooms, public baths, and medical baths require special precautions.

February 8.—Mr. Francis Jones, president, in the chair. —G. **Hickling**: The anatomy of *Calamostachys Binneyana*, Schimper. It was shown that the so-called "nodes" at which the sporangiophores arise are not true nodes. There is no secondary xylem at that level, the protoxylem canals are not obliterated, no "gaps" are seen in the cauline bundles, and the medulla is not modified as at the true node. The slender vascular traces supplying the sporangiophores may be arched before entering them. Below the sporangiophore the traces may occasionally be seen lying on either side of the corresponding cauline bundle, often freed from it by maceration. There is considerable evidence to show that the sporangiophore trace preserves its identity down to the subjacent true node. The axes, which are commonly described as possessing six bundles in three pairs, are shown to possess only three single bundles. Both three and four bundles are proved by serial sections to characterise different parts of the same cone. There is some evidence that the alternation of the bracts has been brought about by their lateral displacement. It was shown to be possible to obtain good series of sections by grinding the blocks containing the material and taking photomicrographs of the successively exposed surfaces.—L. E. **Adams**: A hypothesis as to the cause of the autumnal epidemic of the common and the lesser shrew. The fact that more corpses of shrews are found in autumn than during the other seasons of the year has been a standing puzzle to naturalists, and no wholly satisfactory explanation has hitherto been suggested. The known agencies of destruction, such as conflicts among themselves, attacks of enemies, scarcity of food, and drought, whilst resulting in many deaths, fail to account for the sudden rise in mortality during the autumn. The author, as the result of observations and investigations carried out during a number of years, is decidedly of the opinion that the autumnal "epidemic," as it is called, is due to nothing more than old age, old age in the case of the common and the lesser shrew being reached in, roughly, thirteen or fourteen months. This conclusion is supported by the fact that all specimens of the common and lesser shrew trapped during and after December in a series of years were found to be immature. This hypothesis would account also for the absence of wounds and other marks of violence in many of the corpses found.

Royal Meteorological Society, February 23.—Mr. H. Mellish, president, in the chair.—Dr. W. **Makower**, A. J. **Makower**, and Miss M. **White**: Investigation of the electrical state of the upper atmosphere made at the Howard Estate Observatory, Glossop.—A. W. **Harwood**: The results of twenty-five registering balloon ascents made from Manchester on June 2–3 last. These were sent up at intervals of one hour, and some extremely interesting and valuable results were obtained from them.—R. G. K. **Lempfert** and R. **Corless**: Line squalls and associated phenomena.

DIARY OF SOCIETIES.

THURSDAY, March 10.

Royal Society, at 4.30.—The Causes of the Absorption of Oxygen by the Lungs (Preliminary Communication): C. Gordon Douglas and Dr. J. S. Haldane, F.R.S.—The Action of Nicotine and other Pyridine Bases upon Muscle: Dr. V. H. Veley, F.R.S., and Dr. A D. Waller, F.R.S.—Studies on Enzyme Action. XIII: Enzymes of the Emulsin Type: Prof. H. E. Armstrong, F.R.S., and E. Horton.—Preliminary Note on the Origin of the Hydrochloric Acid in the Gastric Tubules: Miss M. P. Fitzgerald.—The Extinction of Sound in a Viscous Atmosphere by Small Obstacles of Cylindrical and Spherical Form: C. J. T. Sewell.—The Ionisation of Various Gases by the β-Rays of Actinium: Dr. R. D. Kleeman.

Mathematical Society, at 5.30.—Forms for the Remainder in the Euler-Maclaurin Sum-formula: W. F. Sheppard.—The Scattering of Light by a Large Conducting Sphere: J. W. Nicholson.—The 3-3 Birational Space Transformation: Miss H. P. Hudson.

Institution of Electrical Engineers, at 8.—Short Circuiting of Large Electric Generators and the Resulting Forces on Armature Windings; The Design of Turbo Field Magnets for A.C. Generators with Special Reference to Large Units at High Speeds: Miles Walker.

Royal Society of Arts, at 4.30.—Indian State Forestry: Saint-Hill Eardley-Wilmot.

FRIDAY, March 11.

Royal Institution, at 9.—Ionisation of Gases and Chemical Change: Dr. H. Brereton Baker, F.R.S.

Physical Society, at 8.—On Coherers: Dr. W. H. Eccles.—Earth-air Electric Currents: Dr. G. C. Simpson.—An Automatic Toepler Pump designed to Collect the Gas from the Apparatus being Exhausted: Dr. B. D. Steele.

Malacological Society, at 8.—Pleistocene, Holocene, and Recent Non-marine Mollusca from Mallorca. Marine Shells from Alcudia, Mallorca: Rev. R. Ashington Bullen.—Classification of the Gastropoda: R. J. Lechmere Guppy.—On the Occurrence in England of *Valvata macrostoma*, Steen: A. S. Kennard and A. W. Stelfox.—Description of a New Species of Helicodonta from Spain: G. K. Gude.

Royal Astronomical Society, at 5.—On the Determination of Cœlostat Errors: E. B. H. Wade and H. E. Hurst.—(1) Note on Star Colour Nomenclature; (2) Corrections to Colour-spectrum Discordances: W. S. Franks.—Encke's Comet, 1895–1908: O. Backlund.—(1) Meteoric Fireball of 1910, Feb. 17; (2) Meteoric Fireball of 1910, Feb. 28: W. F. Denning.—Measures of Double Stars made at the Royal Observatory, Edinburgh: Royal Observatory, Edinburgh.—*Probable Papers*: On the Systematic Motions of the Stars derived from the Cross Proper Motions of the Bradley Stars: Prof. F. W. Dyson.—The Envelopes of Comet Morehouse (*c*1908): A. S. Eddington.—Notes on Comet *a*1910: Rev. A. L. Cortie.

SATURDAY, March 12.

Royal Institution, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

MONDAY, March 14.

Royal Society of Arts, at 8.—The Art and History of British Lead Work: L. Weaver.

TUESDAY, March 15.

Royal Institution, at 3.—The Emotions and their Expression: Prof. F. W. Mott, F.R.S.

Zoological Society, at 8.30.—A Contribution to the Skeletal Anatomy of *Chlamydoselachus anguineus*, Garman: T. Goodey.—On the Variation of the Sea-elephants: Prof. Einar Lönnberg.—On the Alimentary Tract of certain Birds, and on the Mesenteric Relations of the Intestinal Loops: F. E. Beddard, F.R.S.

Mineralogical Society, at 5.30.—A New Form of Petrological Microscope, with Notes on the Illumination of Microscopic Objects: G. W. Grabham.—On Datolite from the Lizard District: W. F. P. McLintock.—A Suggested Modification of Stereographic Projection: Dr. J. W. Evans.—Exhibit of Models illustrating the Space-lattices and Sohncke's Regular Point-systems: Prof. H. L. Bowman.

Royal Statistical Society, at 5.—Notes on the Financial System of the German Empire: Wynnard Hooper.—The Increased Yield per Acre of Wheat in England considered in Relation to the Decreased Acreage: H. D. Vigor.

Illuminating Engineering Society, at 8.—Discussion on the Measurement of Light and Illumination.

Institution of Civil Engineers, at 8.—Birmingham Sewage-disposal Works: J. D. Watson.—Salisbury Drainage: W. J. E. Binnie.

WEDNESDAY, March 16.

Royal Society of Arts, at 8.—The Foundations of Stained Glass Work: Noel Heaton.

Royal Microscopical Society, at 8.—Antipatharians from the Indian Ocean: Miss S. B. M. Summers.—(1) On the Visibility of the Tertiaries of *Coscinodiscus asteromphalus* in a Balsam Mount; (2) Critical Microscopy: E. M. Nelson.

Royal Meteorological Society, at 7.30.—Climatic Influences in Egypt and the Sudan: Captain H. G. Lyons, F.R.S.

Entomological Society, at 8.

THURSDAY, March 17.

Royal Society, at 4.30.—*Bakerian Lecture*: The Pressure of Lig[ht] against the Source: the Recoil from Light: Prof. J. H. Poyntin[g], F.R.S., and Dr. Guy Barlow.

Institution of Electrical Engineers, at 8.—*Further discussio[n]* (1) Short Circuiting of Large Electric Generators and the Resulting Forc[es] on Armature Windings: (2) The Design of Turbo Field Magnets for A.[C.] Generators with Special Reference to Large Units at High Speed[s]: Miles Walker.

Institution of Mining and Metallurgy, at 8.—Annual Meeting.

Linnean Society, at 8.—The Life-history of *Chermes himalayensis*, Ste[bbing] on the Spruce, *Picea morinda*, and Silver Fir, *Abies Webbiana*: E. [P.] Stebbing.—A Contribution toward a Knowledge of the Neotropic[al] Thysanoptera: R. S. Bagnall.

Institution of Mechanical Engineers, at 8.—Compounding a[nd] Superheating in Horwich Locomotives: G. Hughes.

FRIDAY, March 18.

Royal Institution, at 9.—The Dynamics of a Golf Ball: Sir J. [J.] Thomson: F.R.S.

Institution of Civil Engineers, at 8.—The Construction of Warship[s]: N. Maas.

SATURDAY, March 19.

Royal Institution, at 3.—Electric Waves and the Electromagne[tic] Theory of Light: Sir J. J. Thomson, F.R.S.

CONTENTS. PA[GE]

THURSDAY, MARCH 17, 1910.

THE LIFE OF LORD KELVIN.

'he Life of William Thomson, Baron Kelvin of Largs. By Silvanus P. Thompson. Vol. i., pp. xx+584; vol. ii., pp. xi+585–1297. (London: Macmillan and Co., Ltd., 1910.) Two vols. Price 30*s.* net.

THE task of the biographer is, in several respects, a very different one from that of the scientific istorian. Indeed, it may be affirmed with some hadow of truth that the best biography belongs to he domain of imaginative literature. For to be erfectly successful the biographer must make a hero f his subject; in other words, he must, as an artist, dealise without destroying the features he endea-ours to portray. Too often he is a mere ordinary hotographer who removes wrinkles and smooths ver defects, and thereby produces a picture, recog-isable indeed, but of a man in unnatural pose, and ill t ease in holiday garments. Again, the true artist oes not crowd his canvas too much, nor does he labour he details of his picture too diligently; we are not empted to look through our magnifying glasses at articular parts of it, to our loss of the effect of the hole. Finally, he must write from personal know-edge, and with the warmth of personal affection; ut he must not allow his feelings to outrun his iscretion, or permit his devotion to blind him to the act that his hero shared the limitations of ordinary umanity. It is just to say that Prof. Thompson asses these tests with a fair measure of success. His ography is well and sympathetically written, it fords a vivid, and, on the whole, a true picture of ord Kelvin as a student of science, as a university acher, as an engineer and man of affairs, and as the lleague and friend of a large circle of those devoted science. If here and there—for example in the count of the latter part of Lord Kelvin's student reer and of the proceedings at the Kelvin jubilee—e detail is worked with too microscopic minute-ss, the lines are generally bold enough to show e man and his work in fair proportion, and to ive the reader with a feeling of contentment with e manner in which the story of a great life has been d and its achievements recounted.

The task of the scientific historian has already been empted by Larmor, who has framed an estimate of rd Kelvin's work such as hardly anyone else could ve composed at the present time. But that work l not be seen in its true perspective until some erval of time has elapsed; its full effect on the gress of science cannot until then be traced in ail in the complicated web of scientific fact and ory which so many artists have woven, each inter-ting the part of nature's design which lay before eyes.

'he sketch of Prof. James Thomson, Lord Kelvin's her, and of college life in Belfast and Glasgow in second, third, and fourth decades of the nine-nth century, is somewhat more meagre than it ht have been, perhaps; and a little later, when the 'essor of mathematics appears again, the picture seems a little out of focus. Tales of his efficiency, and of the respect and admiration with which his students regarded him as a teacher, are still current among the few Glasgow graduates who remember the old college as it was in those days, at the beginning of the last quarter of a century of its existence. But no doubt many of the readers of Prof. Thompson's book, like the present writer, have come to it fresh from the perusal of the charming account of the family life of the Thomsons contained in Miss Agnes King's recently published "Lord Kelvin's Early Home"—the reminiscences of Mrs. King, Lord Kelvin's eldest sister—a narrative which, Prof. Thompson tells us, he has purposely refrained from trenching upon.

Prof. James Thomson's oral examinations are still spoken of as stimulating and instructive, and his example was followed with success in Aberdeen by David Thomson, who went there to be professor of natural philosophy after teaching Dr. Meikleham's classes during the years that preceded William Thomson's return from Cambridge. But the power of effective oral examination, like that of maintaining order without effort, is the result of a certain almost indefinable personal quality which many highly gifted men do not possess. The advent of Dr. James Thomson put an end at once to the pea-shooting and other antics in which the students of mathematics had previously indulged; and his personality impressed itself in other ways on university discipline and the conduct of university affairs, through his influence as a member of the Faculty, which, not the Senatus, was then the administrative governing body. In later days the respect which the students felt for William Thomson's scientific eminence, and the controlling force of his temperament, combined to preserve order in his presence and prevent the most daring from taking liberties. His oral examinations, however, were rather an occasion for digressions, which, though highly interesting and instructive in themselves, were not always such as to recall and elucidate the topics dealt with in the previous lecture.

The old college, Prof. Thompson says, was surrounded with horrible slums, and no doubt its environment was sufficiently wretched. This should not be misunderstood. Things were not always so bad in that part of the city, and at the present time, thanks to the Glasgow City Improvement Trust, the conditions of life in the east end have been greatly improved. In the 'thirties and 'forties, when the Thomsons lived in the residential court of the college, the old order of things was passing away. Bailie Nicol Jarvie no longer lived over his counting-house, and the tobacco lords and other wealthy merchants, grown distrustful of the comforts of the Saltmarket, were migrating from Virginia Street to comfortable villas and self-contained houses in the west end, where in a freer air and more healthful surroundings they lived a not much less frugal life. The birth and development of engineering established factories on the Clyde, and brought labourers and mechanics from all quarters. The lanes of the east end were transformed, from places not very different from those which abut against

some of the colleges of Oxford and Cambridge, to rookeries of the worst description. The University had either to await the amelioration of these surroundings, which came later, or leave its beautiful old quadrangles to seek a new home where no such environment existed. Since its establishment on Gilmorehill, it has found the growth of engineering science react enormously on the study of natural philosophy; and now a great new Natural Philosophy Institute and the James Watt Engineering Laboratories exist together, within hearing of the clang of hammers in the great practical laboratories of the Clyde, with which, by their students and the practical problems which continually arise for solution, they are kept constantly in touch. The opening of this institute and of other new buildings by the Prince of Wales on April 23, 1907, was the last public ceremony at which Lord Kelvin presided as Chancellor of the University. The conferring of honorary degrees on the Prince and Princess, which was only one of the incidents of the ceremony, is mentioned by Prof. Thompson; but the real occasion of the visit, directly connected though it was with Lord Kelvin's own work in the University, has somehow escaped his attention.

A full account is given of Lord Kelvin's undergraduate career at Cambridge, and of the visit to Paris which followed it. By that visit, which he made at the suggestion of his father, and with introductions obtained by him, the young mathematician benefited in many ways. He made the acquaintance of Cauchy, Chasles, Liouville, Sturm, and Regnault, and besides studying French—and the cornopean—under Parisian teachers, devoted himself to practical physical work under Regnault, who was perhaps the greatest experimentalist of the century. He received no systematic instruction in experimenting—there was then no provision for such instruction, nor for long after was any provided at any university—but he was present to work the air-pump or to hold a tube, or to stir a calorimeter when told to do so, and thus learned something of the technique of physical manipulation. It must be admitted that he never became himself an expert at such work; and his natural impetuosity in later years, when the irons he kept in the fire were almost innumerable, made his presence in the laboratory a source of perturbations which seriously interfered with the systematic progress of research. Thus there was just a shade of truth in the legend—written on the blackboard by a laboratory student when the knighthood after the laying of the 1866 Atlantic cable was announced—"The (k)night cometh when no man can work"!

The story of his election to the chair of natural philosophy in 1846 is told in detail, and it is interesting to read the principal testimonials presented by Thomson, which have been printed from a complete set in the possession of Dr. Hutchison, of Glasgow. There can be no doubt that he had already impressed all the scientific men whom he had met with his extraordinary ability and promise, and all who support his candidature—including MM. Regnault and Liouville, and Hopkins, Fuller, Leslie Ellis, and De Morgan, predict for him a distinguished future as an investigator. In an appendix to chapter v. (the subject of which is "The Young Professor") is printed the famous introductory address which was annually brought out to be read at the first meeting of the natural philosophy class for the session, but which was invariably departed from within the first three or four minutes, and laid aside to be taken up again only after the lapse of another year. It was a matter for regret that it was not read through each year—it *was* read through in 1846, in much less than the allotted time, and Thomson was so disconcerted that he could find nothing to go on with!—for its language is simple and yet dignified, and well fitted to impress the minds of youthful students beginning the study of natural science. In this address he distinguishes between what he calls "mental history" and "mental philosophy," and between "natural history" and "natural philosophy." He says that

"What may by the analogy of terms be called *mental history*, that is to say, a combination of personal experience and a knowledge of men and of manners, with the study of politics and history, leads us to reason upon the abstract properties of mind, and to investigate that system of general laws on which *mental philosophy* is founded. So in the study of external nature, the first stage is the description and classification of facts observed with reference to the various kinds of matter of which the properties are to be investigated; and this is the legitimate work of *Natural History*. The establishment of general laws in any province of the material world, by induction from the facts collected in natural history, may with like propriety be called *Natural Philosophy*."

Thus the observations, and their comparison and classification, which led to Kepler's laws, belong to the "natural history" of celestial mechanics; Newton's deductions from Kepler's laws, and the theory of universal gravitation, which accounts for all the motions of the planets, belong to the "natural philosophy" of the subject. The fundamental subject of natural philosophy is said to be dynamics, or the science of force, and it is interesting to find the importance of this foundation insisted upon for all the principal divisions of physics. Referring to three of these—heat, electricity and magnetism, he says:—

"Our knowledge of these branches of the science is not so far advanced as to enable us to reduce all the various phenomena to a few simple laws from which, as in mechanics, by means of mathematical reasoning, every particular result may be obtained; but observation and experiment are the principal means by which our knowledge in this department may be enlarged. Hence what is called the experimental or physical course includes these three subjects; while the more perfect sciences of mechanics [here he means "dynamics"; "mechanics" he always defined as the science of machines] and optics, being really mathematical subjects, form a distinct division of the studies prescribed by the University for the complete course of Natural Philosophy."

Thomson does not seem to have dwelt on the deductive processes of mathematical physics in this address, though these are quite as important as the induction with which they must be combined. The deductive process by which Adams and Leverrier m

out the place of the planet Neptune from the perturbations of Uranus gave a result which, when found to agree with observation, was generally regarded as affording a much more forcible proof of the truth of the gravitational theory than all the induction which preceded it, and the same thing may be said of results in other departments of physics, which illustrate the *predictive* value of a true theory. A reference to Adams and Leverrier, and the discovery of Neptune, was made in the address, but after 1862 it was omitted by the advice of Prof. Tait, who thought that the subject of Neptune had been "ridden to death."

The provinces of heat, electricity and magnetism, which are referred to in the introductory address as lying in great measure outside the scope of dynamics, it was Thomson's destiny to bring under the sway of the science of forces. He is already, when in Paris, meditating on the results set forth in Gauss's great memoir on attracting and repelling forces varying inversely as the square of the distance, and noticing how the general theorems there given lead to conclusions which were afterwards expressed in the language of the theory of energy. The letter (quoted on p. 130) is interesting in this connection and in some others.

"April 8, 1845. To-day, in the laboratory (of Physique at the Coll. de France, M. Regnault, Prof.), I got the idea which gives the mechanical effect necessary to produce any given amount of free electricity, on a conducting or non-conducting body. If m is any electrical element, v the potential of the whole system upon it, the mechanical effect necessary to produce the distribution is Σmv. . . . Also the theorem of Gauss that Σmv is a mimim. when v is const., shows how the double int[l] which occurs when we wish to express the action—directly, may be transformed into the diff.-co. of a simple int[l] taken with reference to the distance between the two spheres. . . . This has confirmed my resolution to commence experimental researches, if ever I make any, with an investigation of the absolute force of statical electricity. As yet each experimenter has only compared intensities by the dev[ns] of their electrometer."

Here we have the train of ideas in progress which led, no doubt, to some of the series of papers on the mathematical theory of electricity which were published later in the *Cambridge and Dublin Mathematical Journal*. But what is still more particularly to be remarked is the determination to measure forces in absolute units. In the discussions of Lord Kelvin's work which have appeared in print, hardly sufficient importance has been attached to the part which Thomson played in the working-out of the scheme of absolute measurements the beginnings of which were made by W. Weber and Gauss. Perhaps, as he confessed later in one of his addresses, he never succeeded in getting the capacities of the leyden jars in his laboratory expressed exactly in absolute units, but it became possible to obtain a fair estimate of these capacities, and to measure, also in absolute units, by means of the beautiful electrometers which he afterwards made, the potentials to which the jars were charged, and therefore to say approximately, in ergs, how much energy was stored up in a particular jar when charged to the measured potential. Each experimenter, he says, expressed his results in terms of the deflections of his own electrometer: not merely was that the case, but currents were measured by each experimenter in divisions on his own galvanometer, and the insulation resistance of a cable at one time could only be compared with its value at another time by using the same instruments as before and reproducing exactly the former conditions. All this had to be swept away and an absolute system substituted when Atlantic cables began to be laid; but an enormous amount of exceedingly valuable work, both theoretical and experimental, had to be done ere a proper system could be elaborated. No small amount of this was accomplished by Thomson and his volunteer laboratory corps at Glasgow, in the "coal hole at the old college," as some members of that corps have since described the famous "first laboratory for students." Then the toil which the members of the British Association Committee undertook in working out, perfecting, and realising the system of units! It was work which did not attract public attention or strike the public fancy; and yet hardly anything else has done more to render possible practical applications of electricity in all their modern ramifications.

In the early 'fifties came the papers on the theory of heat. The account of Carnot's theory of the motive power of heat, with its determination of Carnot's function from Regnault's experiments on steam, valuable as it was, seems to have led Thomson's thoughts into a kind of groove, from which, when Joule's proof that heat and work were equivalent was published, he had some difficulty in escaping, and which involved him in considerable perplexity. It is, as Prof. Thompson says, entirely to the credit of Clausius that he saw clearly at once the full force of Joule's discovery, and accepted implicitly the first law of thermodynamics to which that discovery pointed. After that the necessary modification of Carnot's theory followed immediately, and Carnot's notion of a cycle of operations enabled the whole of the immediate consequences of the true dynamical theory to be worked out. A little later, but independently, Thomson also arrived at the true theory, and by an "axiom," or rather postulate, very differently expressed from that employed by Clausius, but on the whole equivalent, showed that the efficiency of all ideal thermodynamic engines, no matter what their working substances were composed of, had the same value. This in Thomson's hands led afterwards to his definition of absolute temperature, a conception which Prof. Tait used to insist, in the pages of NATURE and elsewhere, was of the most enormous importance, and ought to be set forth at the outset in every treatise on the subject.

Thomson's great paper, followed up as it was by developments and applications of the theory in his later writings, was destined to exert a profound influence on the study of thermodynamics both in this country and abroad. This result was in part due to the peculiarities of his treatment of the subject, which were characteristic of his practical genius.

The object of the memoir is first clearly announced, then the process and its results are unfolded, with a reference at every principal step to the physical meaning of the operation performed and the result obtained; and in every part the process adopted is preceded by a carefully worded statement of the assumptions made, and the presuppositions involved. Clausius, on the other hand, and with him almost every Continental writer, begins by referring to an undefined substance called a "perfect gas," and by means of that substance absolute temperature is defined as R/pv, where R is a constant and p and v are respectively the pressure and volume of a given mass of the gas. Thomson obtained his scale of temperature by means of an ideal engine; and then came the comparison of his scale with that of the air thermometer, by means of his porous plug experiment, which he carried out in collaboration with Joule, in the famous series of experiments on the thermal effects of fluids in motion. This experiment falls at once into clear relation to the whole theory in Thomson's sequence of ideas; this is hardly the case in the other mode of treating the subject.

The earlier papers on heat were all communicated to the Royal Society of Edinburgh, of which Thomson became a fellow in 1847. Of this society he was Keith medallist in 1864, and one of the chief grounds for the presentation of the medal was the discovery of the theorem of minimum energy of a system of connected particles, started by impulses applied at specified points and subject to the condition that the velocities of these points have specified values. This theorem is stated by Prof. Thompson on p. 1141, with rather less than sufficient caution; for if the condition be that the *impulses* applied at the specified points are also specified the motion is one of maximum energy. The far-reaching scope of this theorem is now much better understood than it used to be; for example, by analogy, certain theorems of electricity may be regarded as particular cases of it. The whole subject of these general dynamical theorems has been discussed by Lord Rayleigh in his "Theory of Sound."

The appointment of Tait to the chair of natural philosophy in Edinburgh led to the literary partnership which had as its result the publication in 1867 of the first volume of the "Treatise on Natural Philosophy," and in 1873 of the companion volume, "The Elements of Natural Philosophy." It is matter of keen regret that the second volume at least of the treatise was not forthcoming. For continually in his lectures in 1874, and for some years later, Thomson referred to the discussion of properties of matter which would be contained in that volume, and references to it are frequent in vol. i. If that chapter had been given to the world the treatises on electricity, sound, and hydrodynamics, which we owe to Maxwell, Lord Rayleigh, and Lamb, might well console us for the abandonment of the original scheme. But, as it is, all the old Glasgow students of natural philosophy, who have kept up the study of the subject, will ever regret the loss of the promised chapter, of which they obtained now and then glimpses, when Thomson referred, for example, to the difficulties of the elastic solid theory of the æther, and showed that similar difficulties arose when we attempted to explain the properties of cobblers' wax!

A good idea of Tait's breezy and energetic style of work will be obtained from the letters printed at p. 453, and elsewhere. He was a man of the most kindly feeling and disposition, though the native force of his character and intellect made him a formidable opponent and a severe critic and controversialist. His famous lecture on force will never be forgotten by those who heard it in the Kibble Palace, in Glasgow, in 1876; only a faint idea of it can be obtained by reading his "Recent Advances in Physical Science." He was orderly and methodical; his statements, whether oral or written, were brief and precise, and his lectures were commended by all his students for their unfailing experimental illustrations and the clearness of their expositions.

Thomson could also be clear and precise, nobody more so; but in his popular discourses he was always so preoccupied, and every thought so inevitably suggested new and interesting relations of things, that all his hearers, except a very few, quickly gave up the attempt to follow his lecture, and settled down to listen in admiration and amazement. The writer will never forget the discourse on "Isoperimetrical Problems" which Lord Kelvin delivered at the Royal Institution in May, 1893. The half-humorous picture of the wounded Horatius Cocles limping after the plough, and drawing his furrow so as to get the greatest possible area of land within the given length of boundary, brought the problem home to even the most unmathematical dweller in Mayfair who was present; but when the lecturer went on to make Horatius take account at every step of the quality of the soil, so as to place the maximum value of corn land within his boundary, wonder melted into sympathy for the crippled warrior confronted with such a terrible task! It is well known that the Friday evening discourses must begin at nine o'clock and terminate precisely at ten; but this law, which no one else dared to break, Lord Kelvin disregarded, for when ten o'clock came he had just got into his subject, and he went on—with apologies, of course—until nearly eleven! Such were his fire and enthusiasm; and to the few who remained to the end the *tour de force* was amazing. This would never have happened with Tait; the whole matter would have been thought out from beginning to end; all ideas that might have led him from his straight path would have been ruthlessly put aside, and a model of polished and clear exposition presented. As a rule, Thomson's sentences, both written and spoken, were too heavily loaded with saving clauses; as if he considered himself too absolutely committed to a conditional statement, if its limitations were not all given with it in one word-formula.

It is little wonder in some ways that the literary partnership broke down. But the book was, as Prof. Thompson has called it, emphatically an epoch-making one. It called for and brought about a return to Newton in dynamical method; and it pointed out how the neglected *scholium* on Newton's third law contained in substance the theory of energy. Other text-books are more popular; even the "Elements"—

consisting as it did in many places of the large-type statements of the treatise, without the small-type mathematical demonstrations—was too strong meat for the babes of the Glasgow class. The muttered groans of the students, when on Friday Thomson would first ask them to read twenty or thirty pages of the book before Monday, and then turn to McFarlane and tell him to see that questions were set on the part prescribed in the forthcoming Monday morning examination paper, never reached his ear, and with a bland smile, as if he had just prescribed a novel for the week-end, he used to turn to his oral examination and his lecture.

With regard to the somewhat strong remarks, which we find quoted on p. 445, as to the absurdity of causing Thomson to teach elementary physics, it is right to say that in 1846, when he sought and obtained the chair, the plain everyday duty of the professor of natural philosophy was to teach the natural philosophy class, and that, so far as Thomson was concerned, his time, energy, and original power were far from wasted in meeting from day to day his band of students, most of them eager to learn, and many of them willing to help in his researches. There is no doubt whatever that the attempt to teach them gave him inspiration, and from them came, as another important reward, his laboratory corps, who helped him so much. Witness the tribute to the divinity and other students in the Bangor address. Moreover, it does not seem to be generally known that from the early 'seventies onwards Thomson met the ordinary class only twice, and the higher class only once, a week. He would most certainly have been himself the strongest objector to any arrangement that would have cut him off altogether from his ordinary students. The reflection on the University is undeserved.

Prof. Thompson's second volume begins with 1871, in which year Thomson was president of the British Association at its meeting in Edinburgh. During the following fifteen years or so he was at the height of his activity. His Atlantic cable-laying expeditions were over in 1869, and he had purchased the *Lalla Rookh*, and begun the series of yachting excursions and hydromechanical and other experiments at sea which resulted in the compass and sounding machine. A year or two later some further cable-work was undertaken, which occasioned an eventful visit to Madeira; and then came the introduction into navigation of the fully corrected compass and the sounder, which are now in one form or another on board every well-found and properly equipped sea-going vessel. In the 'eighties he delivered the Baltimore lectures, and invented the various standard electrical instruments for exact laboratory and workship measurements. Afterwards, in the 'nineties, came the peerage, the presidency of the Royal Society, and the never-to-be-forgotten jubilee celebration in 1896.

Of Lord Kelvin's cable work, both theoretical and practical, extending from 1857 to 1874, and of his many other practical activities, Prof. Thompson's book contains an admirable account. It is written in such a way that anyone, however non-mathematical or non-physical, can read it with interest and enjoyment. No such person can lay down the second volume without a feeling of amazement that so much achievement in high regions of scientific discovery and invention could be crowded into one life, even though that extended far beyond the Psalmist's three score years and ten. Indeed, the book may do much good by telling the public at large how much it is indebted for its safety in travelling, for telegraphic communication from continent to continent and between the old world and the new, and for many other benefits (to say nothing of the advancement of natural knowledge), to patient investigation carried on by one man and his corps of willing students and assistants.

There are a few corrections here and there that we should like to see made in a new edition, but these are not of any great consequence, and need not be here enumerated. We have come to the end of the space allotted to this review, and only a few points here and there have been touched upon. The thronging memories of the past suggest innumerable topics on which we might dwell. All around are memorials of the great man who has passed away and the work he carried through. But it is better to forbear, and in a last word to commend Prof. Thompson's book to all who care to know something of the life and the victories of a leader of the armies of peace.

A. GRAY.

DYNAMIC ELECTRICITY.

Electricity. By H. M. Hobart. Pp. xix+207. (London: Constable and Co., Ltd., 1909.) Price 6*s.* net.

IN this book the author attempts to impart to the reader a fundamental knowledge of dynamic electricity without using mathematics, or rather without giving mathematical proofs of his statements. He evidently believes in the possibility of such study, for in the preface he says that

> "Without any accompanying study of other text-books, almost anyone who is in earnest can make good progress in acquiring a fundamental knowledge of the subject of electricity, by a careful study of the present treatise."

Now this is rather an ambitious statement, but if the author had followed the orthodox method of using mathematics in elucidation of experiment he might have succeeded. He has, however, deliberately discarded the use of the most efficient tool we have in the interpretation of experimental results, and thus the task of the reader is made more difficult, and not more easy, as he hoped to make it. The author cannot do entirely without mathematics, or at least without expressing certain relations by mathematical formulæ, but he gives these without showing how they are obtained, merely as statements without proof. Here are a few examples: on p. 59 we are told that a circular conductor 1 cm. long, and carrying 10 amperes, acts on a unit pole in the centre of the circle with a force of 1 dyne. No proof is given for this statement, yet, starting from this, the author develops, also without mathematical proof, the law that the magnetic field round an infinite straight con-

ductor varies inversely as the distance from the conductor. On p. 83, merely as a footnote, we get a simplified version of Minchin's formula for the total flux through a coil of circular cross-section, and on p. 85 Perry's formula for the flux through a coil of rectangular cross-section. On p. 87 we find the well-known formula for the induction in the centre of a long solenoid, but in none of these cases is a proof given.

This tendency to do without mathematical reasoning is surely futile; a reader who does not know even the small amount of mathematics which suffices for the elementary study of electricity had better leave the subject alone; and the reader who has the required mathematical knowledge is not helped by finding the most simple relations set forth in long tables and perfectly obvious diagrams. Yet the book is interesting to the man who knows the subject. He will find many things, which are treated in all text-books in the orthodox way, presented in a different manner, and although the treatment is sometimes rather verbose, it is at any rate original. As regards nomenclature, the originality is perhaps carried a little too far. That the term "kelvin" is used to denote the unit ordinarily called the kilowatt-hour might be passed over as permissible, since some other authors have adopted the same term, though it is by no means generally accepted; but there is no justification for introducing the term "siemens" for the watt-hour. This unit is hardly ever used, and to coin a special term for it is quite unnecessary. The terms "continuous electricity" and "alternating electricity" are also unusual, whilst the abbreviation "ats" for ampere-turns is not very happily chosen.

The first six chapters, dealing with the specific resistance of conductors, the conception of current, voltage, energy, power, and explaining Ohm's law, are very elementary. The definition of the unit of energy, taken as the kilowatt-hour, is unusual. According to the author's nomenclature, the "kelvin" is that amount of energy which will raise the temperature of a ton of water by 0·86° C. This is surely a roundabout way for a book on electricity, especially as the conception of the mechanical equivalent of heat is not used to connect the "kelvin" with the "joule," but the relation between the two units is simply stated in a table.

The following chapters deal with the magnetic field, the E.M.F. generated in moving conductors, alternating currents, inductance, the magnetic circuit, and insulating materials. The passage dealing with the relation between time and current in a circuit to which an E.M.F. is suddenly applied is an object-lesson of the futility of attempting to treat such a subject without mathematical basis. It cannot be done; and thus we find Helmholtz's formula suddenly introduced without any proof, and then worked out at great length algebraically for a special case. Then we get to the time constant and more numerical calculations, with the usual complement of tables and curves. The best chapter in the whole book is that on insulating materials. Here we get on to the solid ground of experimental evidence. Tables and curves are given for the disruptive strength of a great variety of insulating materials, the influence of temperature is discussed, as are also the methods of testing for disruptive strength and the thickness of slot insulation found necessary from practical experience. The specialist who has to design high-pressure machinery will find this part of the book very useful.

Gisbert Kapp.

AN ARTIST-ORNITHOLOGIST IN EGYPT.

Egyptian Birds, for the Most Part seen in the Nile Valley. By Charles Whymper. Pp. x+221; with 51 coloured plates. (London: A. and C. Black, 1909.) Price 20s.

WE have nothing but praise for Mr. Whymper's drawings. Being more in the nature of landscapes with birds in the foreground than figures of birds with a suitable background, they naturally gain from an artistic standpoint, and this has not detracted from their value as guides towards identification. Many of the drawings are, indeed, most pleasing pictures, and convey a delightful impression of the surroundings amongst which the visitor to Egypt may expect to see the birds depicted. On the whole, Mr. Whymper has not suffered greatly at the hands of the block-maker, though we may remark generally that the colouring of the plates is more pleasing by artificial light than by daylight, and we imagine that the green legs and feet of the griffon vulture, the purple hues of the chats, and such like inaccuracies in colouring are due to the engraver's or printer's art rather than to the artist's.

Whether the author has been wise in his choice of "types" of Egyptian birds—only some fifty or sixty species in all are figured and described—is perhaps a matter for argument, but in a book which aims at teaching the traveller in Egypt "something of the birds he sees," it seems a waste of opportunity to devote plates and descriptions, amongst so few, to such birds as the kingfisher, house-sparrow, heron, snipe, and lapwing, which every Englishman who takes the smallest interest in birds must know; while the inclusion of the shoebill, which has never occurred in Egypt, because it is a favourite at the Giza Zoological Gardens, is really absurd—one might as well include the giraffe in an account of the mammals of England! The use of the book as an aid to identification is thus very small, for it will help the average Englishman to identify barely forty birds which he does not already know, and the volume is a large one for so small a gain in knowledge.

Turning now to the letterpress, the author disarms minute criticism by his statement that the book is not intended for the ornithologist, but he implies that its purpose is, in some measure at all events, educative, so that we may fairly point out some inaccuracies, for we cannot commend the author's ornithology in the same spirit as we can his art. As an example, we may direct attention to the description of the crested lark, in which not a word is said of there being a number of well-marked geographical races of this bird peculiar to different localities in Egypt—obviously a very interesting point which, had it been explained.

would have caused Mr. Whymper's readers to look carefully at the crested larks they saw instead of passing them over as "nearly the commonest birds." Which form is represented in the plate it is difficult to say, but certainly neither the almost black *Galerita cristata nigricans* of the Delta nor the pale, sandy-coloured *G. c. altirostris* found to the south of Cairo could be recognised from the drawing.

Again, on p. 76 the extraordinary statement is made that the red-spotted bluethroat has never occurred on migration in Germany, and that it flies without a halt from Africa to Scandinavia. Because many of the migrants which occur in winter in Egypt are of the same species as those which occur in north-western Europe in summer, it is unreasonable, we think, to suppose that they are the same individuals. The further statement that the bird is but an accidental visitor to Great Britain, and hardly worthy of a place on the list of our birds, should also be corrected, since it has been proved during the last ten years, at all events, to be a regular annual bird of passage in the autumn. We have no wish to criticise unduly, but we think it behoves an author to be even more careful of his facts in a popular book of this kind than in a book intended for readers who would not be so likely to accept his statements unchecked.

The ornithologist reading Mr. Whymper's pages may cull a few observations of interest, such as a note here and there on the winter habits of some of the migrants. The list of birds at the end of the volume is so far from being complete that we cannot think that it has been revised by Mr. M. J. Nicoll, who is credited with having assisted the author in making it "as complete as possible."

THE EVOLUTION OF AGRICULTURE.

Die Entstehung der Pflugkultur. By Dr. Ed. Hahn. Pp. viii+192. (Heidelberg: C. Winter, 1909.) Price 3.60 marks.

IN the study of culture-origins there seem to be three working hypotheses. According to one, institutions and material inventions were, so to speak, "forced" upon man by the various exigencies of his life. "Necessity is the mother of invention." According to another, religion, or rather magic, initiated such steps in progress. A third combines these; a step when made was enabled to persist and be improved by the influence of religion.

But each of these hypotheses, as others, takes into account the psychological factors. How did the idea of an invention occur? It is the first step that counts; given the first step, for instance, in the evolution of the bow, and the rest is easy. How, then, did man hit upon the first step? Among the conditions to be posited are "play" and accident. There is a good deal to be done in the investigation of the first steps of what may be called the primary inventions.

Dr. Eduard Hahn has written many volumes and papers on economic history and culture-origins. He is a suggestive writer, and is always ready with a comparison between modern and primitive "diapasons," in Lamprecht's phrase for social atmospheres. The present volume is more or less supplementary, as an answer to criticisms of his theory of the origins of agriculture.

This theory is the magical-religious. It has been severely criticised, and we must admit that in this restatement and defence Dr. Hahn fails to convince. His method is almost as elliptic as Prof. Adolf Bastian's. A closely reasoned argument confined to one detail, for instance, the relation of the "Moon Goddess" to the evolution of husbandry, and employing careful analogies when a step is taken from one people to another, or from one culture-stage to another, would have had better results. But he seems to rely on the cumulative effect of data which are of the most diverse nature and value. Thus we have in unequal yoke a piece of folklore from Hesiod or Macrobius, with a savage practice of the Australian Arunta and a German peasant custom. But his theory is too fanciful to be able to rely on such data.

The points of the theory are mainly these: the basis of primitive subsistence was vegetable, not animal. The three-stage hypothesis of hunting, herdsmanship, and husbandry is traversed. The primitive *Hackbau* is distinguished from agriculture proper, *Pflugbau*. Woman was the chief agent in primitive economics, as the "gardener" with her digging-stick. Thus far the theory is sound. But it proceeds to urge the "religious" *origin* of the domestication of animals, of the use of milk, of the wagon and its wheels, and of the plough, all in connection with the cult of the Moon. Much is made of the sporadic indications of the connection of phallicism with the "idea" of ploughing.

Dr. Hahn's sketch of the primitive symbiosis of Headman, Medicine-man, and Woman is good reading. The Medicine-man protects the primitive "crop" from ghostly enemies, and secures for it ghostly strength. The Headman organises material defence, and, when free, the ordinary male hunts. But primitive society was probably not quite like that; in particular it is easy to exaggerate the influence of "religion." A. E. CRAWLEY.

OUR BOOK SHELF.

A Manual of Locomotive Engineering. By W. F. Pettigrew. Third edition, revised. Pp. xv+356. (London: C. Griffin and Co., Ltd., 1909.) Price 21s.

WE had pleasure in noticing the first edition of this book some ten years ago, when a favourable opinion was expressed as to its value as an educational means of assisting students of locomotive engineering in its many phases.

The author claims to have brought the work thoroughly up to date, and, considering the tremendous advances made in this branch of engineering during the last ten or more years, we naturally expect some evidence of really modern practice in the third edition. It is very disappointing to find this is not the case. Plate i. illustrates what the author describes as "the new outside cylinder express engines designed by Mr. W. Adams," &c. As Mr. Adams joined the majority

some years ago, and as the engines referred to were designed many years before then, it is absurd to illustrate them as modern practice when the magnificent creations of Mr. Wilson Worsdell on the North-Eastern and those of Mr. McIntosh on the Caledonian are available.

The compounding of locomotives has also been very seriously considered by many engineers, particularly during the last ten or twelve years. The Webb and Worsdell systems being more or less obsolete, one naturally expected to find the Smith system with three cylinders, which originated on the North-Eastern, engine No. 1619 being the prototype, described and illustrated by one of the recent Midland compounds. Another type of compound represented by the four-cylinder engines on the North-Eastern is conspicuous by its absence.

Of the subject of superheat, which is now being seriously considered by most locomotive engineers, we find no reference in this volume. This is surely a serious omission when there are locomotives running on certain railways in this country fitted with the Schmidt system, a system which claims many economies in working when compared with the heavy boiler expenses involved when working with the high pressures necessary with the compound engine.

Although we have considered it necessary to point out that the author's claim of having brought the third edition of this book up to date has more or less failed, it should be clearly understood that its contents are of a valuable nature, and budding locomotive engineers should obtain a copy without delay. It is certainly one of the best books of its kind. The illustrations are good and the general style excellent.

Matter, Spirit, and the Cosmos. Some Suggestions towards a Better Understanding of the Whence and Why of their Existence. By H. Stanley Redgrove. Pp. 124. (London: W. Rider and Son, Ltd., 1910.) Price 2s. 6d. net.

MR. REDGROVE'S theory of matter is that it possesses only a hypothetical reality; we assume its existence only because otherwise the harmony of our individual worlds would be unintelligible. Spirit, he seems to maintain, we know by direct intuition of ourselves —a proposition of great dubiety, if we take spirit in the sense of real substance. But, granting the one a certain, the other a hypothetical objectivity, the objective relation of the two must be determined. Mr. Redgrove holds that God is the ultimate cause of both, spirit the mediate cause of matter. Yet the effect must be regarded as quite distinct and discrete from the cause. It would seem to follow that for God spirit is something analogous to what matter is to us; but this inference is not drawn. Moreover, no reason is given for the ontological subordination of matter to spirit, except the epistemological distinction noticed above; and it might equally be held to prove the ontological subordination of all other spirits to one's own. Mr. Redgrove, indeed, tentatively holds that in telepathy we have direct "sense" of other spirits; but this perception is "symbolic" as well as direct, which means, one must suppose, that it is not truly immediate. The author believes in the immortality of self-conscious beings; but as he also believes that self-consciousness arises out of protoplasmic consciousness by the ordinary processes of the universe, it is not evident why he should assume the impossibility of a relapse into that state. Though these and other difficulties will be met, the book is well worth reading. Mr. Redgrove writes with precision and force, and his discussion is always interesting.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Colour of Water.

I AM reminded by Lord Rayleigh's lecture on this subject of the splendid light-blue colour presented by the tanks of water in which some of the water companies allow the sedimentation to take place of "hard water" which has been treated by Clark's process. I am thinking of those near Caterham and of those at Plumstead. The tanks—to the best of my recollection—are about 20 feet by 40 feet in area and 15 feet deep. The water in the tanks has become perfectly (or nearly) clear, whilst the sides and bottom of the tanks are made brilliantly white by the deposit of calcium carbonate. The intense blue colour is seen at (practically) any angle of vision, and on a sunless, overcast day as vividly as in sunshine. It would be important to ascertain whether the blue colour thus seen is entirely due to the self-colour of the water or whether the phenomenon is in any way due to the minutest white particles of calcium carbonate which are still floating in the apparently clear water, and are acting as do the particles of a blue vapour-cloud. I suppose that it would be an easy thing for a physicist to determine this by the use of a polariscope at the side of the tank.

Also the introduction of black tarpaulin into the tank so as to prevent the reflection of light from the bottom and sides would show whether any amount of blue colour was still exhibited by the water, such colour being then necessarily due to the reflection of light from suspended particles, and not from the sides or bottom. A more satisfactory method would be to draw off (without disturbing the sediment) the blue-looking water into an adjacent tank previously lined with dead-black.

One observation on the colour of water I may venture to record. In a very large porcelain (so-called) bath in a hotel bath-room, where strong sunlight was admitted by a window some 10 feet above the bath, the walls of the room being colourless, I noticed that when the bath was filled to a depth of 20 inches the water had a distinctly blue colour. The porcelain, whilst pure white above, yet *beneath* the water had a distinctly blue appearance, and the intensity of the colour varied with the movement of the water in waves or ripples. The colour was blue rather than greenish-blue, and this I attributed to the pure white of the porcelain as contrasted with the yellowish tint of enamel. The water in question was that supplied in the Hotel Ritz, in Paris (I think that of the Vanne).

E. RAY LANKESTER.

The Stability of an Aëroplane.

I HAVE been much interested in reading Prof. Bryan's statement on the subject of the stability of an aëroplane, but I cannot agree with him in thinking that the solution of the problem is to come from the mathematical side. I should be the last to decry the use of mathematics in such a case, but if the final result is to be absolutely trustworthy, there must be no doubtful assumptions made during the process.

It does not appear, from the article written by Prof. Bryan, whether he has taken the viscosity of the air into account, but I presume that he has done so. Perhaps, also, his solutions are only meant to apply to the case of an aëroplane flying in a dead calm. The practical difficulty with a flying machine is the natural wind, and if flying machines are to be of any real use they must be able to maintain their stability in ordinary conditions of weather. Now it is obvious that when a flying machine has once left the ground it is quite immaterial to the stability, provided the air motion is perfectly uniform and steady, whether the velocity of the wind be one mile or one hundred miles per hour, since it is only the relative motion of the machine and the air with which we are concerned; but, as a matter of fact, a wind of from ten to twenty miles an hour is fatal to almost every aëroplane, and the

reason is not far to seek. The air motion known as wind is not even approximately steady and uniform until at least a height of 1000 feet is reached, and on some days there is no uniformity about it until much greater heights are attained. The supposition made, therefore, that the motion is uniform is incorrect, and if this assumption has been made by Prof. Bryan it limits the use of his equations to times of perfect calm.

He has probably also assumed that the flying machine, or at least the separate parts of it, may be treated as a rigid body. The small gliders made of thin mica, and described by Mr. Lanchester, may, no doubt, be treated as rigid, but cloth or canvas forms an important part of an aëroplane, and however tightly it may be stretched it certainly is not equivalent to a rigid sheet, but must yield under varying pressure.

My practical experience on this subject is with kites, and although there are fundamental differences between a kite and a flying machine, there are many points of resemblance, and it is probable that if the question of the stability of a kite could be completely elucidated, that of the stability of an aëroplane would follow. Almost any kite will fly in a steady wind of moderate velocity, but, so far as I know, there is no kite that will remain stable when the wind increases beyond a certain value. The limit with the kites used here is about forty-five to fifty miles an hour at a height of 1500 feet. The question is, Why do they become unstable? There are, perhaps, three reasons. The flying of a kite depends on gravity, for a weightless kite could not fly, as there would be no directive force. As the wind pressures increase, the necessary relationship between the magnitudes of the pressures and the weight is lost, and the kite becomes unstable. A cure, perhaps, lies in increasing the dead weight. Secondly, the stresses produced by the strong wind very likely deform the kite. It is not possible to meet this by increased strength, for increased strength means stronger, and therefore heavier, materials, and hence, unlike a dead weight at the centre of gravity, a greater moment of inertia, which, as I have long known from practical experience, and Mr. Lanchester has shown from the theoretical side, is inimical to stability. Thirdly, it may be that there is a certain critical velocity, like that of water in a pipe, beyond which the motion over the edges of the sails becomes turbulent, and the form of the stream lines suddenly changes.

These points can best be cleared up by extensive experimental work, and I much regret that no such work is being done. W. H. DINES.

Pyrton Hill.

IT was difficult to prevent my article from running to ten times its present length, and a similar difficulty occurs in this letter. I can only state that the more I have examined the problem of stability the more I have been brought to conclusions exactly the opposite to those expressed in Mr. Dines's letter. My original view was to limit the mathematical investigation to the formation of the biquadratics and their discriminants, leaving their coefficients to be determined by experiment. In several popular articles I have advocated such experiments. Further experience has shown that there was little prospect of any conclusions of a practical character being obtained without a considerable further development of the problem from the mathematical side.

Moreover, experience has led me to believe that the English practical man is sometimes right when he says that if you cannot get a complete solution of a problem you ought to try to obtain the nearest approach to it that you can, and, further, that an admittedly approximate solution is often more useful than a more complicated exact one. In the present case the methods are perfectly general, and while it would have been futile to start, in the first instance, by making the problem too complicated, there is little difficulty in introducing any necessary modifications subsequently.

In regard to the assumption of uniform relative velocity, surely Mr. Dines is confusing the issues between stability and something else. The very notion of *stability* implies the existence of a state of equilibrium or of steady motion. The behaviour of an aëroplane or kite in a turbulent atmosphere is a problem, not of stability, but of forced oscillations. The effect of these oscillations is to modify the motion of the kite; but it is necessary in the theory of forced oscillations to assume as a standard of comparison the state of equilibrium or steady motion which would exist if the disturbing forces were absent, and the character of the forced oscillations will depend vitally upon whether this state of equilibrium is stable or unstable. The first thing is to investigate the free oscillations, but there is nothing to prevent the investigation extending to forced oscillations as well. It is only a question of time and opportunity. Meanwhile, aviators are performing record flights on aëroplanes which do not satisfy the conditions of stability, and Mr. Dines's turbulent air currents are getting blamed for much that is not their fault. No solution of the problem can be final which does not completely separate the effects of free and forced oscillations. I do not see how this can be done by purely experimental methods of investigation, and surely the questions which Mr. Dines raises in connection with the behaviour of kites refer to this very point. He has, in fact, stated another problem for the mathematician.

Again, like Mr. Dines, I was at first of opinion that it might be possible to establish a simple connection between the stability of an aëroplane and that of a kite, and I suggested this problem to Mr. Harper. The investigation turned out to be more complicated and less likely to lead to any practical conclusions than was originally anticipated. With so many other problems on hand, it appeared desirable to give this one up for the present. I do not think Mr. Dines will find it possible to obtain an experimental solution. If he can, a great deal of trouble will be saved; but so many variables enter into the problem that it appears to me necessary to start with some idea as to what the connection is likely to be, *i.e.* with some kind of a mathematical theory as a starting point.

When Newton published his "Principia" it would have been an easy matter for a forerunner of Mr. Dines to raise objections to this attempt to solve problems relating to moving bodies by applications of the laws of motion on the ground that the motions must largely depend on air resistance, friction, the earth's rotation, and other causes, and that a solution which did not take all these effects simultaneously into account could be of no practical value. Similarly, it might have been objected that the solution of the problem of stability of ships could not be approached by means of the theory of the metacentre on the ground that it failed to take account of wave motion, the velocity of the ship, the effects of the wind, and such resistances as viscosity. I venture to suggest that if the above problems had been attacked by purely experimental methods alone, we might still have been in the dark as to their solutions.

In my article I alluded to difficulties caused by "want of opportunity," but out of fairness reference ought to have been made to the similar difficulties referred to in Mr. Lanchester's book. Had his investigations been published when they were made, a large amount of work might now have been accomplished which is still undone.

It is only fair also to add that since the appearance of the note I have had some correspondence with the editor of the *Aëronautical Journal*, and I hope he will succeed in maintaining the same high standard in its published papers of a mathematical character as in its illustrated articles on general aëronautics. G. H. BRYAN.

Colour-Blindness.

IN the issue of NATURE of January 27 there is a discussion of colour-blindness, with particular reference to the case of Mr. John Trattles, whose colour-vision seems to have been difficult to determine. It is not my purpose to discuss the peculiarities of this case, or the methods of examination used by the Board of Trade. As a worker in this branch of science, however, I may be permitted to say that in any case of supposed defective colour-vision there need be no appeal from the opinion of Sir William Abney, who is so justly celebrated on both sides of the Atlantic for his researches on the perception of colour.

Since, however, in the case of Mr. Trattles, and possibly in others as well, the evidence was not regarded as con-

clusive by all the examiners, it is most desirable that some method should be used about which there could be no doubt whatever. Such a method, I believe, is one founded on the exact measurement of the persistence of vision of colours throughout the spectrum, when the frequency of flicker is at its critical value. The only thing the person under examination has to do is to adjust the speed of a sectored disc so that the flickering of the part of the spectrum under observation just ceases. The speed of the disc may be automatically registered on a chronograph by electrical means. A series of measurements throughout the spectrum when plotted gives a "persistency curve," which can readily be compared with a similar curve for a normal eye. The great advantage of this test is that it is purely mechanical, and does not involve the handling of coloured materials or the judging of colours in any way by the candidate.

A careful study by this method of twenty-six cases of colour-blindness which I made some years ago ("Persistence of Vision in Colour-blind Subjects," *Phys. Rev.*, vol. xv., 1902) showed such systematic differences between eyes with normal and those with abnormal colour-vision that I am convinced it is the most exact method yet used for the study, not only of colour-blindness, but also of normal colour-perception. I can the more readily express such an opinion inasmuch as this method, though used very extensively by myself, was originally devised by Prof. E. L. Nichols.

In the article in NATURE there is the statement that in the study of colour-blindness "there is none of that accuracy of definition in the scientific picture which rejoices the heart of the physicist." To some extent this may, perhaps, be true, especially for very strong or weak intensities of stimulus. On the basis of the cases I have referred to above, I venture to assert that, for ordinary daylight, there is far more "accuracy of definition" than is usually supposed to exist. I do not know how many cases of colour-blindness must be studied to render the conclusions drawn therefrom reasonably sure, but those to which I refer can readily be divided into distinct classes on the basis of three fundamental colour-sensations, red, green, and violet.

Holmgren, I believe, first pointed out the possibility of the following varieties of colour-blindness:—

Red-blindness ... ... Green-blindness ... ... Violet-blindness	Defective in *one* colour sensation.
Red-green blindness ... Red-violet blindness ... Green-violet blindness ...	Defective in *two* colour sensations.
Red-green-violet blindness or total colour-blindness	Defective in *three* colour sensations.

In the paper on colour-blindness referred to above, there is, I believe, a demonstration of the existence of each of the above types with the single exception of violet-blindness. This classification, which was arrived at by means of persistency curves, seems to me to be as definite as could almost be desired.

I would therefore suggest this method for the examination of at least doubtful cases of defective colour-vision. The only objection is that the measurements, while simple and easily performed, are somewhat tedious if the spectrum is to be thoroughly examined.

FRANK ALLEN.

Physics Department, University of Manitoba, Winnipeg, February 11.

Practice and Knowledge.

MR. AND MRS. HOWARD in NATURE of February 17 show that "the past history of agricultural science furnishes several examples of belated explanations of the utility of practices the value of which has long been a tradition among practical men." In other departments of life practice in advance of knowledge is frequent, and there is one which struck me recently, and may have been observed by others, which is the practice of blowing hot and cold with the mouth which Æsop makes use of in his fable of the "Satyr and the Traveller," and has given rise to the common disparaging saying of "blowing hot and cold."

Some may suppose that the whole explanation of blowing hot and cold may be in the difference in temperature of the two bodies blown on; the Traveller's hands in Æsop's fable were colder than his breath, while the heated mulled wine was warmer. This, however, is only a partial explanation. We have unconsciously acquired the practice of blowing at different temperatures. If we wish to warm our hands we open the mouth wide and direct a slow moving current of air to them, or, more properly expressed, we breathe on our hands. This current has nearly the body temperature; but when we wish to blow cold we purse in the lips until there is only a small opening, as in whistling, and discharge a fine jet of air under pressure. This jet entangles a large amount of air with it, and when it arrives at the hot surface its temperature is much lower than that of the breath. Should the hot surface be also moist, the current of air quickens the evaporation, and so hastens the cooling.

In passing, it may be noticed here that Æsop and the modern use of the expression "blowing hot and cold" seem to have missed the mark. The objects blown on are not the same, but different, and require and receive different treatment. It is no disparagement to say of a man that he blew hot on a scheme which seemed to him to require encouragement, while he blew cold on another he thought ought to be suppressed. Æsop putting the words into the mouth of a being of the type of a Satyr seems to suggest he was not quite sure he had given the highest interpretation of the incident recorded in the fable.

JOHN AITKEN.

Accelerated Velocity of Jupiter's Red Spot Hollow.

THE longitude of the middle of the Hollow has shown a comparatively rapid diminution since the beginning of the present apparition, as the figures below clearly indicate:—

Month	Mean longitude	Diminution	Month	Mean longitude	Diminution
	°	°		°	°
1909 October ...	15·3	... —	1910 January ...	8·8	... 3·0
1909 November...	13·3	... 2·0	1910 February ...	7·4	... 1·4
1909 December...	11·8	... 1·5			

From its estimated position on October 25 and February 25 (the first and last dates of observation in the above table), a rotation period of 9h. 55m. 37·9s. (287 rotations) has been deduced. This is 2·7 seconds shorter than the adopted period.

If the present accelerated rate of motion continues until June next, the centre of the Hollow will arrive at λ 0°, or, rather, its longitude will coincide with the zero meridian of system ii.

Now this quicker velocity became evident towards the end of the last apparition. An examination of my transit-chart of the Red Spot region for that epoch shows that, up to the beginning of May, 1909, the Hollow exhibited a normal monthly increase in longitude of 1·0°. Subsequently it began to move decidedly quicker, and this acceleration has been well maintained up to the present, as will thus be seen:—

Date	λ	Elapsed rotations	Rotation period h. m. s.	Remarks
	°			
1908 Dec. 20 ... 1909 May 2 ...	13·6 18·1	321 ...	9 55 42·1	May 2 chosen as approximate date of change in velocity
1909 May 2 ... 1909 June 12 ...	18·1 18·4	99 ...	9 55 40·9	The last transit of the apparition was taken on June 12
1909 June 12 ... 1909 Oct. 25 ...	18·4 15·3	327 ...	9 55 40·5	Planet invisible for greater part of time between the two dates
1909 Oct. 25 ... 1910 Feb. 25 ...	15·3 7·0	287 ...	9 55 37·9	Hollow in conjunction with S. Tropical Dark Area, since January

The approximate date when the present accelerated velocity first commenced may be regarded as May 2, 1909.

The recent behaviour of the Hollow, or the Red Spot, is attributed to one well-known phenomenon. Once about every twenty-three months the Great South Tropical Dark Area passes rapidly by the Spot, and on each occasion the latter temporarily participates in its movements. As it is now two years since we witnessed the last of these periodical occurrences, the dark matter, having swept round the planet, is once again involving the region of the Red Spot. The recent accelerated motion of the Hollow, therefore, was fully anticipated.

March 4. SCRIVEN BOLTON.

A Radium Experiment.

IT is usual to demonstrate the ionising property of radium by discharging an electroscope. The reverse experiment of charging an electroscope, or Leyden jar, is more effective, and can be made to ring a bell.

If a wire, about 6 inches in length, is coated with a salt of radium and placed *in contact* with the knob of an electroscope, the latter will quickly become charged if any charged body is placed within 2 or 3 feet. A small Wimshurst machine is very convenient for the demonstration, as it can be easily turned about to reverse the charge, or placed equatorially, when no effect is produced.

It is a good plan to arrange the leaf of the electroscope to discharge itself automatically to earth at a divergence of about 45 degrees; then the charging is repeated so long as a charged body is in the vicinity. Instead of sending the discharge to earth it may pass into a coherer, and so ring a bell or give a record.

When an induction coil is used it is easy to show that the prepared electroscope will keep on receiving a charge for some minutes after the coil is stopped; for instance, after working an 18-inch coil for one minute, some charge was given to a delicate radium-tipped electroscope when brought into the room four minutes later.

This duration of charge on air can be distinctly shown by filling a large paper bag with charged air and rapidly conveying the same to a Wilson electroscope in another room.

This is obviously due to a residual charge in the air, which persists long after re-combination of mixed ions. This arrangement of a radio-active body near, or, better, in actual contact with, a delicate electroscope is a very sensitive detector. The effect is not quite so good if the radio-active coated wire is placed in contact with the charged body, leaving the electroscope free. Upon exploring the charged air of a room, it is usually found to be divided into two areas of opposite charge; these can be mixed by waving an umbrella, so yielding a neutral mixture.

The fact that a charge is so easily acquired by an electroscope must be taken into consideration during delicate testing, for the mere act of withdrawing a vulcanite pen from the pocket will give a negative charge to a distant electroscope in ionised air.

F. HARRISON GLEW.

156 Clapham Road, London, February 5.

SUBSTITUTES FOR RUBBER.

THE present demand for india-rubber naturally directs attention to those articles which, to a greater or less degree, may serve to replace rubber in its industrial applications, and so help in conserving the supply.

Of such articles a very large number have been proposed. Those in actual use to any considerable extent are, however, relatively few. For present purposes the various surrogates may be distinguished as (1) rubber-substitutes proper, consisting wholly of ingredients other than rubber; (2) composite or "artificial" rubbers, which contain a certain proportion of natural rubber worked up with other substances; and (3) true synthetic rubber, namely, a product containing the rubber molecule synthesised in the laboratory or factory by chemical means from simpler compounds.

At present the first of these classes is commercially the most important. Scores of recipes are in existence, including very diverse ingredients; but the basis of most is a modified oil. At first sight there seems little suggestion of india-rubber in the properties of an ordinary vegetable oil, but a simple experiment will indicate the kind of modification which certain oils readily undergo, and which help to fit them for use as rubber substitutes. If we test the drying properties of boiled linseed oil by spreading a little of it over a slip of glass and allowing it to dry, a film of oxidised oil is eventually obtained, having a certain modicum of toughness and elasticity. The liquid oil has taken up oxygen, and thereby become converted into a more or less elastic solid. Tung-oil substitute is essentially such an oxidised product, manufactured by heating the raw oil until it has absorbed enough oxygen to cause it to thicken and become solid on cooling, when it is powdered and worked up with a little petroleum.

In a somewhat similar way the oils can be made to take up sulphur, becoming thereby solid, and endowed in some degree with elastic properties. The treatment is analogous to the "vulcanisation" of rubber. "Brown" or "black" substitutes are manufactured by heating the oil with sulphur, a process corresponding to the "hot cure" method of vulcanisation. "White" substitutes may be made by merely mixing the oil, cold, with 20 to 40 per cent. of sulphur chloride; or, better, by first dissolving the oil in a suitable solvent such as carbon tetrachloride. This resembles the "cold cure" process used in vulcanising rubber. Colza oil is largely used for these purposes, but various others are available—linseed, maize, arachis, and castor oils, for example. The chemical reaction involved is a somewhat complicated one, but probably it consists mainly in the formation of what chemists term an "addition-product." The proportion of sulphur taken up by the substitutes varies rather widely, ranging from 5 to upwards of 15 per cent. As would be expected, oils which have previously been oxidised to a notable extent (*e.g.* "blown" oils) require less sulphur to saturate them than do the natural oils.

"Nitrated" oils are also used as the basis of some rubber surrogates. Thus one well-known product is a solution of a nitro-cellulose in linseed or castor oil which has been nitrated by treatment with a mixture of nitric and sulphuric acids. Other such articles are made by oxidising the nitrated oil with lead peroxide, or by simply heating it in air.

These oxidised, sulphured, and nitrated oils, in one form or another, are largely used as substitutes for rubber. Of the other substitutes proposed, a few examples may be given, to indicate something of their general nature.

First there are those which, while still retaining oil as one ingredient, include also other important constituents. Thus, "Fenton's rubber" is a mixture of oils with tar, pitch, and creosote; which mixture, when digested with nitric acid, gives a toughened mass, and this on heating yields an elastic product simulating rubber. "Russian" substitute, said to be useful for covering telegraph cables, contains as ingredients wood-tar, hemp and linseed oils, ozokerite, spermaceti, and sulphur. "Oxolin" is made by impregnating fibrous material such as jute or hemp with linseed oil, oxidising the oily mass with warm air, and working the product up between rollers into a coherent mass, which can then be vulcanised by heating it with sulphur.

In another category of substitutes oil plays only a subordinate part, or is altogether dispensed with. Thus "Jones's substitute" is stated to be made from various gums and gum-like products as the chief constituents. In W. H. Perkin's patent (23,031/07), gelatine or glue is dissolved in creosote and then treated with some reagent—potassium bichromate, formaldehyde, or tannic acid—which will render the gelatine or glue insoluble; after "setting," the mass obtained is digested with acetone to make it firmer. "Textiloid" has for its ingredients various resins, nitrocellulose, and camphor. As a curiosity in this class may be mentioned "grape rubber," produced from the skins of grapes by means of pressure; it is not, however, a commercial article. Finally, though this can only be

a substitute for rubber in very hard articles, we may mention the interesting material, "bakelite," recently introduced by Dr. L. H. Baekeland. It is a condensation-product of formaldehyde and phenol, which can be moulded as desired, and afterwards hardened.

In what sense are the foregoing articles and their likes to be considered as "substitutes" for rubber? Some persons are disposed to deny them any right to the title, and would look upon them as mere adulterants whenever used partially to replace rubber in what would otherwise be an all-rubber article. Others admit, though sometimes grudgingly, that there is a place which such substitutes can usefully fill. Much depends on what the article is sold as, and on what use it is to be put to. Not all the special qualities of rubber are wanted in all the products for which it is employed. A door-mat is one thing, a bicycle tyre quite another. Where a high degree of elasticity is not really needed, as, for instance, in waterproof goods and electrical insulating work, there is a legitimate field for substitutes which may serve the required purpose. Even here they may not be equal to rubber, but they find their justification in their lower cost. After all, we do not need razors to cut sticks with.

It may be said at once that no substitute is equal to rubber in every respect. Chemically, the latter is a very inert substance—much more so than the substitutes. Hence, even if the latter were not otherwise inferior, they would be less durable than rubber under certain conditions. They are nearly all acted upon more or less readily in circumstances where rubber remains unharmed. The modified oils, in fact, are still oils in the sense that they remain glycerides, decomposable by alkalies, as also by steam under pressure. If used for articles exposed to these agencies, they fail in durability, whatever their excellences otherwise.

The fact that substitutes of this class are readily saponifiable by alkali makes it an easy matter to detect them by analysis when compounded with true rubber. As a rule, the proportion of substitute used is from 5 to 25 per cent., and even the smaller quantity is recognisable.

Of the composite rubbers (or "artificial rubbers," as they are sometimes called), one preparation, which has been made in quantity, and is said to be excellent for many purposes, has for its basis Guayule rubber incorporated with certain gums. Another such article is compounded of natural rubber and some other substance of vegetable origin, probably a latex or a gum, reputed to contain the same chemical elements as rubber and in much the same proportion. Such articles are, of course, only partially "substitutes" for rubber, and their cost rises with that of the latter ingredient. Moreover, if any very large demand for them arose, there is always the possibility that the supply of gums and latices would become insufficient, and the advantage of lower cost would thus tend to disappear.

Coming now to true synthetic rubber; a question often asked is whether there exists any probability of such an article being manufactured and displacing natural rubber, either wholly or to any large extent. Will rubber plantations go the way of madder fields and indigo cultivation? Well, the future is on the knees of the gods. In the face of the precedents just mentioned, to say nothing of others, he would be a bold man who would venture to say that even the best quality of rubber may not some day be made on a commercial scale from cheaper materials such as beet sugar and calcium carbide. But the day is not yet. There are beginnings; there are clear indications of the direction in which to proceed; there is distinct progress to note. But there is still some distance to go, and the end of the journey may not be even in sight.

India-rubber chemically is essentially a polymerised terpene. An article patented some time ago, and named "turpentine rubber," appears to foreshadow a synthesis of true rubber. Turpentine is a mixture of terpenes, and the article in question was to be obtained by passing turpentine through a hot tube, and treating the resulting vapours with hydrochloric acid. The result is a solid condensation-product; and the idea at the base of the process appears to be the production of polymerised terpenes having some of the elastic properties of rubber.

A more promising, because a more scientific way, is that outlined in Heinemann's patent No. 21,772 of 1907. Here a true synthesis is attempted. It is based upon the well-known fact that rubber is probably a polymer of the semi-terpene isoprene. The first step is the production of the unsaturated hydrocarbon divinyl, $CH_2 : CH.CH : CH_2$. This is obtained by passing mixed acetylene and ethylene gases through a heated tube. With methyl chloride, divinyl yields isoprene [methyl divinyl, $CH_2 : C(CH_3).CH : CH_2$]; and the isoprene on treatment with strong hydrochloric acid is converted by a union of molecules into a substance closely resembling caoutchouc, if not identical with it. The raw materials, so to speak, are thus acetylene, ethylene, and methyl chloride, which are themselves obtained by any of the ordinary methods, *e.g.* from calcium carbide, alcohol, and beet sugar residues respectively.

The question is, can this or some other comparatively simple synthesis, theoretically quite possible as a laboratory operation, be translated into a practicable and profitable mode of manufacture on a large scale? One of the first doubts to arise is whether the synthesised caoutchouc will have the physical properties of natural rubber; or whether these, by any course of treatment, can be imparted to it. This doubt resolved, there comes the question of economical production in competition with the natural product. Much time and thought have been spent on the problem of synthetic rubber, and it is safe to conclude that there will yet be many a headache before it is solved. Judging by what is known to have been done rather than by the promises, owners of rubber plantations may for the present sleep peacefully in their beds.

C. SIMMONDS.

REPORT OF THE ROYAL COMMISSION ON CANALS.

THE Royal Commission on Canals and Inland Navigation, the final report of which has recently been issued, was appointed in March, 1906, and consisted of nineteen members, Lord Shuttleworth being chairman. Their instructions were to inquire into the present condition and financial position of the inland waterways of the United Kingdom; to report as to the causes which have operated to prevent the carrying out of improvements by private enterprise; as to improvements desirable in order to complete a through communication by water between the centres of commercial industry, and with the sea; the prospect of benefit to the trade of the country compatible with a reasonable return on the probable cost; the expediency of canals being acquired by public bodies; and the methods by which funds could be provided for their purchase and improvement.

Seven reports and returns have already been issued, and there are four more to follow, including that on the Irish waterways.

The Commission held 106 sittings, and examined 266 canal experts, traders, and others interested in the subject. They personally inspected the most important waterways in this country, and some of those in France, Belgium, Germany, and Holland, and obtained a report from an assistant commissioner on the inland waterways of the Continent.

The final report now issued covers 234 folio pages. It commences with an interesting history of British waterways, and then, seriatim, deals with the different questions submitted for consideration, and concludes with the recommendations at which the commissioners have arrived. These are not unanimous, the minority reports being also given.

Briefly, these recommendations are:—

The formation of a Central Waterway Board, and the transfer to this board of four central lines of canals connecting Birmingham, as the most central trading town of the Midland district, with London, Hull, Bristol, and Liverpool.

If this waterway board, after further investigation, and if satisfied that with regard to general benefit to trade and financial considerations such a course is desirable, it should be empowered to enlarge and improve the existing waterways so as to afford through communication for barges, of 100 tons, between the Midland district and the sea-ports.

The estimate given in the report for constructional works for these four waterways is 17½ millions, the money required for the purpose to be guaranteed by the State. The cost of maintenance, interest, and sinking fund is put at one million.

As already stated, the report is not unanimous. Five of the members sign it with certain reservations, and three members have given separate reports.

The reservations of the five members express their disagreement practically with all the recommendations, their agreement extending only to the historical part, the Scotch scheme, and certain minor matters.

The majority do not appear to have much faith in the scheme they recommend, as they only advise that it shall be carried out if the proposed waterway board is satisfied, after further inquiry, that this would be desirable. They admit that it would not be remunerative, and that the loss would have to be met by the State; that it would be of no benefit to the traders in other parts of England, and that the outlay could only be justified by the advantage it might be to the commerce of the country generally. It is also admitted that even with an improved system of internal waterways a large part of the traffic in goods and minerals must still be carried by the railways, that the system of trade in this country is now so carried on that the traders no longer keep stores of merchandise, but rely on quick and certain delivery of minerals and heavy goods in small consignments, conditions which the canals cannot comply with, and that, owing to this, the introduction of large trucks, which are used for the long distances traversed in the United States, has not been a success here, and this objection would apply with even greater force to barges carrying loads of 100 tons. It is also admitted that if improved waterways were really wanted there would not have been any difficulty in this being carried out by private enterprise.

As to the estimate for carrying out the scheme, this does not include the purchase of the existing waterways, nor the cost of several items such as wharves, warehouses, terminal accommodation, Parliamentary and legal and engineering expenses. In one of the minority reports, the cost of construction and other matters included in the majority report is put at about one-third more than that given.

The evidence given also clearly shows that there is not any analogy between the conditions attaching to the waterways of this country and those on the Continent, which have been developed and improved by State aid, due to the different geographical conditions and the much longer distances over which inland transport extends.

Of the minority reports, that of Mr. Inglis, the present president of the Institution of Civil Engineers, and formerly chief engineer, and now general manager, of the Great Western Railway Company, is a very able defence of the railway companies and their dealings with canals. He points out the injustice of any State-aided effort to revive an obsolete and unsuitable mode of transit, to the detriment of the railways, which have been constructed entirely by private enterprise, and the shareholders of which receive less than three per cent. on the capital expended.

Mr. Remnant, who is a barrister, states his disagreement to the recommendations of the majority of the commissioners on the ground that these are inconclusive and left for future consideration by the proposed waterway board, and that the evidence does not warrant the conclusions arrived at on economic grounds.

Mr. Davison, who is a civil engineer, criticises the findings as to the transport and financial features, and his report contains in a brief form the substance of all the arguments that can be brought against the policy of State acquisition of the waterways. He is of opinion that it is extremely improbable that the traffic estimated for the proposed improved canals would be forthcoming, and that the estimate of the cost for these does not include important charges, and that no attempt is made to arrive at the ultimate cost.

DR. E. PERCEVAL WRIGHT.

WITH the death of Edward Perceval Wright one of the links connecting the old school of naturalists with the modern students of biology is severed. Wright was born in Dublin in 1834, where his father was a barrister. He early evinced a keen interest in natural history, and his enthusiasm in forwarding its study led him to commence to publish, in 1854, the year after his matriculation in Dublin University, a quarterly journal devoted to natural science. It was called the *Natural History Review*, and its publication was continued until 1866. In this journal, in the *Quarterly Journal of Microscopical Science*, in the Transactions of the Linnean Society, the *Journal of Botany*, and in the British Association Reports, he published during the next twelve years a series of papers on the fauna of the south and west coasts of Ireland. His undergraduate studies in botany were pursued under the guidance of Prof. G. J. Allman, and as a student he came into contact with W. H. Harvey, who was then keeper of the Herbarium in Trinity College, and of whom Wright always spoke with the warmest appreciation. In 1858 Wright was appointed lecturer in zoology and director of the Natural History Museum of Trinity College. About the same time he was appointed lecturer in botany in the medical school attached to Dr. Steevens's Hospital. It is surprising to find that while he was thus engaged actively in research and teaching, he also found time to prosecute medical studies with such success that by 1865 he had begun to establish a position for himself among Dublin oculists. But he did not remain in practice long, and,

finding it impossible to pursue his medical work together with his duties as *locum tenens* in the chair of botany during the illness of Harvey, who was then the University professor, Wright definitely gave up his ophthalmological work in 1866. During the same period his attention was directed to the finds of fossils in the Kilkenny Coal-measures, and in 1866 he published, in collaboration with T. H. Huxley, an account of the fossil vertebrata from the Jarrow colliery.

In 1867 Wright went to the Seychelles Islands to study the fauna and flora of that group. Unfortunately all his collecting apparatus and preserving materials were lost on the way out by shipwreck. Notwithstanding this misfortune he succeeded in bringing back an important collection of animals and plants, and in the following years was able to publish a series of papers describing the new and interesting forms collected. These papers, together with others on collections made in Portugal and Sicily in 1868, appeared in the *Annals and Magazine of Natural History*, in the Transactions of the Royal Irish Academy, and in the British Association Reports, 1868–76. Shortly after his return from his travels Wright was appointed to the chair of botany in Trinity College, and he held this position until he resigned it in 1904. In 1874 he was elected secretary of the Royal Irish Academy. While University professor of botany, Wright was chiefly interested in herbarium work, and he devoted much labour and enthusiasm to arranging and indexing the valuable collection of plants belonging to the college. Hence it was no ordinary blow to him when, in 1882, through an ill-considered order of the college authorities, he found the whole collection thrown into confusion, and most of his own labours in the herbarium, and those of his predecessors, dissipated. His despondency was short-lived, and he soon buckled to the weary work of arranging once more, and during the next ten years accomplished, practically without assistance, the task of putting the collection into a condition fit for reference. While at this work he was also engaged, in collaboration with Th. Studer, on the report on the Alcyonaria of the *Challenger* expedition.

Speaking from the experience of one who knew only the latter end of Wright's life, his wide human sympathies won the affection of those who came into close contact with him. He was most desirous to forward younger men's work in science, and generously helped them by all the means in his power. It was a pleasure to him to put his varied and often recondite knowledge of the literature of natural science at their disposal. He showed the liveliest appreciation of the results obtained by the more modern generation of biologists. As a teacher he was more than ordinarily successful in stimulating the enthusiasm of his classes and in implanting in them the desire to carry out investigation. He had considerable powers as a conversationalist, and his travelling companions remained his life-long friends. At the same time he was sensitive to a fault, so that he was often misunderstood by those who were not intimately acquainted with him.

Besides his scientific work, he was deeply interested in antiquarian research, and, as president of the Royal Society of Antiquaries, Ireland, exerted himself by every means in his power to forward the investigation of the antiquities of Ireland. His whole career was marked with affection for his University, and some years before his death he presented Trinity College with a valuable collection of botanical books and journals. Since 1904 his health had been gradually failing, and his previous energetic temperament seemed to desert him. The announcement of his death, which took place on March 4, was a grief but not a surprise to his friends.

NOTES.

The fourth annual meeting of the British Science Guild will be held at the Mansion House, at 4 p.m., on Friday, March 18, under the presidency of the Lord Mayor. An address will be delivered by the Right Hon. R. B. Haldane, F.R.S., and it is expected that Lord Strathcona, the Right Hon. Sir George Reid, Dr. Warren (the Vice-Chancellor of Oxford University), Sir Ernest Shackleton, Sir Alfred Keogh, and Colonel Sir John Young will address the meeting.

We announce with great regret the death on March 4, in his fifty-fourth year, of Prof. K. J. Ångström, professor of physics in the Royal University of Upsala.

The death is announced, on March 14, of Dr. H. Landolt, professor of chemistry at the University of Berlin from 1891 until 1905, at seventy-eight years of age.

The annual general meeting of the Chemical Society will be held on Friday, March 18, when Prof. Harold B. Dixon, F.R.S., will deliver the presidential address, entitled "The Union of Hydrogen and Oxygen in Flame."

We notice with regret the announcement of the death, on March 14, of Dr. J. C. Brown, professor of chemistry in the University of Liverpool, at sixty-seven years of age.

We regret to see the announcement of the death of Prof. E. Philippi, professor of geology and palæontology in the University of Jena, and geologist to the German Antarctic Expedition of 1901–3.

Messrs. Sanders and Co., 71 Shaftesbury Avenue, are making arrangements to hold a series of one-man exhibitions from leaders of natural-history work in photography. The first will open early in May, and will be the work of Mr. Richard Kearton. Admission will be on presentation of visiting card.

A Reuter message from Berlin announces that a regular airship passenger service will be started on May 15 from Munich to Starnberg and Ober-Ammergau. A dirigible of the Parseval type will be used, with a gas capacity of 6700 cubic metres. It will carry twelve passengers besides the crew. It will have two motors, each of 100 horsepower, and will make trips alternately to Starnberg and Ober-Ammergau.

The King of the Belgians has announced his intention to make a grant of 40,000*l.* for investigations into the nature and prevention of sleeping sickness. Stations for the study of the disease will be established, the number of doctors will be doubled, and missionaries will be trained in preventive measures at Leopoldville. King Albert will also give 20,000*l.* for the provision of hospitals for natives of the Congo.

The committee organised a few weeks ago to arrange for a thorough scientific investigation of pellagra appeals for funds to enable it to commission Dr. Sambon to undertake the inquiry. The minimum sum required is 600*l.*, but so far only 230*l.* has been subscribed, including 150*l.* promised by the Colonial Office on condition that a further amount of 450*l.* is found. Subscriptions should be sent to Mr. James Cantlie, honorary secretary and treasurer, Pellagra Investigation Committee, 140 Harley Street, W.

We have been asked to state that the annual general meeting of the Society of Dyers and Colourists will be held this year in the Municipal School of Technology, Manchester, on Friday, March 18, at 4 p.m., when the retiring president, Prof. R. Meldola, F.R.S., will deliver

an address on "Tinctorial Chemistry—Ancient and Modern." The presidency of the society is to be taken over by Sir Frederick Cawley, Bart., M.P.

THE President of the Board of Trade has appointed a new Advisory Committee on Commercial Intelligence. The chairman of the committee will be the President of the Board of Trade, or, in his absence, the senior Board of Trade representative present. The committee is to hold office for three years. The committee is appointed to advise the Board of Trade (*a*) on the work of the Commercial Intelligence Branch and on such matters relating to foreign tariffs and other commercial questions as the Board may refer to them, and (*b*) as to commercial missions abroad or other means of obtaining and diffusing information for the benefit of British trade.

AN international expedition started on March 13 for the Peak of Teneriffe to investigate the effect of high altitudes and sunshine on medical and biological processes. From a note in the *Times* of March 12 it appears that the party included Prof. Pannwitz, of Charlottenburg, the president of the International Commission for the Study of Biological and Medical Effects of High Altitudes and Sunshine; Dr. Barcroft and Dr. Douglas (Cambridge University), representing England; Prof. Zuntz and Dr. Neuberg, representing Germany; Dr. Mascat and Dr. Plasse, representing France; and Prof. During and Dr. H. von Schrötter, representing Austria. Prof. Zuntz has already done work in this direction on Monte Rosa, and his observations will be elaborated by the expedition. Preliminary meteorological work has been done by Prof. Hergesell. Dr. J. Mascat, of Paris, has joined the expedition for the purpose of studying Halley's comet under the favourable conditions afforded by the Peak of Teneriffe. Prof. Müller and Dr. Kron, of the Potsdam Observatory, are expected to join the expedition within a week or two.

THE annual general meeting of the Ray Society was held on March 10. The report of the council stated that the society's publication for 1909, a supplementary part of the "British Nudibranchiate Mollusca," has been delayed owing to Sir Charles Eliot's absence from England. For the present year the issue will be vol. ii., part ii., of the "British Marine Annelids," by Prof. W. C. McIntosh, completing the Polychæta. Two volumes are in preparation for 1911, being vol. iv. of the "British Desmidiaceæ," by Mr. W. West and Prof. G. S. West, and vol. iii. of the "British Tunicata," containing the composite species and completing the work. This will complete Messrs. Alder and Hancock's works published by the society. Of other works in preparation, the first instalment of Dr. Malcolm Burr's "Earwigs of the World" will probably be the issue for 1912. An offer by the Rev. Hilderic Friend to contribute a work on the British earthworms has been accepted. Lord Avebury, F.R.S., was re-elected president of the society; Dr. S. F. Harmer, F.R.S., was elected a vice-president; Mr. F. DuCane Godman, F.R.S., was re-elected treasurer; and Mr. John Hopkinson was elected secretary.

THE death of Dr. A. E. Dolbear, for many years professor of physics at Tufts College, Massachusetts, removes one of the most remarkable of American thinkers and inventors. His inability to exploit his discoveries is alleged by his friends to be the only reason why his name is not more widely known. In addition to pioneer work on the telephone, wireless telegraphy, electric waves, and Röntgen rays, among inventions to be placed to his credit are a writing telegraph, a spring balance ammeter, an electric gyroscope to illustrate the rotation of the earth, and a new system of incandescent lighting. The most notable of his books was "Matter, Ether, and Motion." Prof. Dolbear was born at Norwich, Connecticut, in 1837. After serving as a "bound boy" on a New Hampshire farm, he worked successively in a ship-building yard and a printing office, studying geology, mineralogy, and astronomy in his scanty leisure. Later he "taught school" in Missouri, and worked in the U.S. armoury at Springfield. At the age of twenty-nine he entered the University of Michigan as a student of chemistry, and in six weeks became assistant instructor in that subject. The next year he was appointed an assistant professor in Kentucky University, and then professor of physics and chemistry at Bethany College, West Virginia. While holding the latter post he was three times elected Mayor of Bethany. His main career began in 1874, when the discovery of his scientific ability led to his being called to Tufts College.

A SUMMARY of gales recorded at anemograph stations in 1909 has just been issued by the Meteorological Office. Gales occurred in some part of the British Islands in every month of the year with the exception of June, but naturally gales occurred with far less frequency in the summer than during the winter. The most stormy months were January, October, and December. Strong gales, with a mean wind velocity of 47 or more miles an hour, force 9 of Beaufort notation, did not occur in May, June, or July. The absolute maximum velocity of wind in a gust was at the rate of 90 miles an hour, at Scilly on October 23, but the maximum velocity for an hour for this gale was only 70 miles. The next highest velocity in a gust was 78 miles, at Scilly on January 16, and this was followed, in order, by a gust of 76 miles an hour, at Southport on December 3. Gusts of 75 miles an hour occurred at Pendennis on November 18 and December 2, and at Scilly on December 2–3. No anemograph station had a higher wind velocity than 70 miles for an hour during the year. The summary gives the percentage of frequency of each unit of Beaufort notation at several stations grouped separately for the western and southern coasts combined, and for the eastern coasts and inland stations combined. It is comparatively exceptional at any station for winds of 8 and upwards of Beaufort notation to amount to 1 per cent. of all winds, and winds of gale force are less frequent in the eastern than in the western district.

DR. PENCK, the president of the Berlin Geographical Society, has rightly protested against the idea that there can be any objection to the expedition of any nation helping in Antarctic research on whatever route it may prefer to adopt. The unknown Antarctic area is so vast that any overlap and waste of effort would be deplorable, and the four Antarctic expeditions now being organised will probably be working in sufficiently distant fields to render any formal agreement unnecessary. The German expedition under Lieut. Filchner proposes to start from the Weddell Sea, which will also be used as the base of the American and Scottish expeditions. This part of Antarctica is still absolutely untrodden; the Scottish expedition under Dr. Bruce, which discovered Coats Land, was not able to land on it, and did not even see a convenient harbour. Ice navigation in the Weddell Sea is probably very difficult and uncertain, and Coats Land may be inaccessible in some seasons. The three-fold effort, by increasing the chances of success, is therefore to be welcomed, as at present this part of Antarctica is the most promising of important geographical results. If the three expeditions all establish their landing on this unknown coast, they will each find ample room for independent work.

Interest in the North Polar question has again been roused by the refusal of the Naval Committee of the United States House of Representatives to recommend any honour to Commander Peary until he has submitted proofs of his attainment of the Pole. As an expert committee appointed by the National Geographic Society of Washington, and consisting of three such competent authorities as Dr. H. Gannett, Admiral Chester, and Mr. O. H. Tittman, unanimously agreed that Peary reached the Pole, it may be felt that the Naval Committee might have accepted this verdict. The official committee of the House of Representatives is, however, hardly to be blamed for its caution in declining to recommend a Parliamentary honour until the official data have been published, or at least submitted to it. The scepticism felt by some authorities as to Peary's claim is based partly on his great acceleration after leaving his last white colleagues—his pace increasing from 9·6 miles to 26·4 miles a day on the journey north, and to 44 miles on the southward journey until he rejoined Captain Bartlett—and partly on the statement that he took noon observations at the Pole; at that date the apparent path of the sun, as seen from the North Pole, would have been so nearly horizontal that noon observations would have been practically impossible. The National Geographic Society of Washington has been most intimately connected with Peary, and might be prejudiced in his favour; but no such suspicion could be felt in regard to the committee it appointed. The report of that committee was, however, a brief statement of its conviction, and the materials on which its judgment was based are not yet available for public information. If Peary at his most northern point on April 6 was able to determine noon from the sun, he was probably some little distance south of the Pole. To determine the actual mathematical point of the Pole would be impossible during the hasty journey of a lightly equipped sledge party; but any slight error in the observations would not affect the conclusion adopted by most British geographers that Peary reached sufficiently near the Pole to justify his claim. It is to be hoped, however, that his full data will be soon published.

In *Man* for February Mr. H. A. Rose describes various modes of establishing fictitious kinship now current in the Panjab. Such are the ties between people who have joined in the same pilgrimage; the *páhul* or initiation rite of the Sikhs; the exchange of wristlets by youths, of turbans by men, and sheets by women; adoption by a patron to secure protection. These are important as illustrating the practices of adoption and succession, and they also throw light on the methods by which tribes grew under a process of accretion before the present rigid rules of exogamy and endogamy came to be established.

The Botet collection of fossil mammals from the Pampa of Argentina, belonging to the city of Valencia, Spain, is one of the most important collections of its kind, but has not hitherto been exhaustively studied or described. It comprises, not only fine specimens of the ordinary ground-sloths and glyptodonts, Smilodon, and hoofed mammals, but also several new species and a remarkably well-preserved human skeleton. In view of its scientific interest, Prof. E. Boscá, of the University of Valencia, has arranged to prepare an illustrated descriptive catalogue of the collection, and, as a preliminary to this work, he is at present in London studying the original specimens described by Owen. After visiting the European museums Prof. Boscá will proceed to Argentina to examine the rich collections in Buenos Aires and La Plata.

According to the second annual report, the demonstrations and lectures on natural history and economic subjects instituted by the Norwich Museum Association continue to meet with popular appreciation and support. The subjects of the 1908–9 course included the food of birds, flies as disease-disseminators, fungoid diseases of plants, Norfolk soils, and insect fruit-pests.

In the February number of *Naturen* an anonymous correspondent describes two albino Norwegian lemmings, of which one is figured. Such albinos are stated to be extremely rare. In the same issue another writer contributes a notice of the capture by a trawler of the rare fish *Macrurus coelorhynchus*, a species first described in 1842, and of which very few examples have since been taken.

At the close of an article in the February number of the *American Naturalist* on the question whether regeneration in animals exhibits a repetition of the ontogenetic and phylogenetic processes, Mr. Sergius Morgulis observes that "while the evidence shows that, as a rule, organs originate from similar germ-layers, both in ontogeny and in regeneration, there are also some striking exceptions to the rule. The hypothesis that the method of regeneration is causally influenced by the course of ontogeny is, therefore, quite unnecessary as a corollary. With the elimination of this hypothesis the conception of the atavistic nature of regenerated peculiarities, *i.e.* the conception of a repetition in regeneration of phylogenetic processes, loses its chief logical support. This last theory, however, is also objectionable, (1) because of its inherent inconsistency, (2) because it depends upon more or less problematic assumptions."

In a paper entitled "Ungarnered Grain," published in the January number of the *Victorian Naturalist*, Dr. T. S. Hall directs attention to the need of further research into the natural history of Victoria. Sponges and protozoans, he points out, are still very imperfectly known, and much the same is the case with regard to crustaceans. Among fishes, it requires to be ascertained whether Galaxias spawns in fresh water, while no one appears to be able to produce definite evidence that the Australian eel breeds at great depths in the sea, or if, indeed, it journeys to the ocean at all. Further information is likewise required with regard to the breeding-habits of the native frogs, especially whether or no they require water during the metamorphosis.

To the February number of the *Zoologist* Colonel C. E. Shepherd communicates an account of the ear-bones of fishes, and more especially the one known as the asteriscus. Three pairs of these bones are developed, of which the sagitta is normally the largest, the asteriscus being the otolith found in the lagena of the sacculus, while the third bone is the lapillus. The form of the sagitta has long been known to be more or less constant and characteristic for the different family groups, and the author shows that the same holds good for the asteriscus, of which he claims to be the first to describe and illustrate the details in a number of species. Attention is specially directed to the great development of the asteriscus at the expense of the sagitta—which is reduced to a minute rod—in the members of the carp family. That this cannot be attributed to a fresh-water life is demonstrated by the fact that in the pike and perch the normal relative proportions of the sagitta and asteriscus are retained, and the reason for the special feature in the carp tribe has therefore still to be sought. As regards the functions of the otoliths, the

author is inclined to support the theory that these include both hearing and the maintenance of the bodily equilibrium.

THE February issue of the Bulletin of the Sleeping Sickness Bureau (No. 14, vol. ii.) appears with cut edges, which will be found a great convenience by readers. It contains the usual useful *résumé* of papers dealing with trypanosomes and their agents of transmission, sleeping sickness, &c.

THE Bulletin of the Johns Hopkins Hospital for January (xxi., No. 226) contains two essays bearing on the history of medicine, one an address by Prof. Osler on Michael Servetus, who was done to death for heresy at Geneva in 1553, the other by Dr. Steiner on Dr. Lemuel Hopkins, a distinguished, though forgotten, American student of tuberculosis, who lived in the second half of the eighteenth century.

IN a paper dealing with the sewage-pollution of shell-fish (*Journal of Hygiene*, vol. ix., No. 4, 1909, p. 412) Mr. James Johnstone points out that at present no public authority possesses legal powers to deal with the question of the contamination of shell-fish. Polluted mussels supplied with clean sea-water undergo purification with rapid partial disappearance of the intestinal bacteria contained in their tissues—in four days, for instance, the number of contained bacteria had been reduced by about 93 per cent.

THE annual report for 1908 of the curator of the technological museums in Sydney has been received. Special reference is made to the collection of building and ornamental stones, in connection with which a brochure, containing coloured reproductions of specimens quarried in the colony of New South Wales, was issued. Notice is also given of a forthcoming volume on the "pines" of Australia, similar to the monograph on the Eucalypts, which will deal with the economics of Australian conifers.

THE action of light on the expansion of buds of woody plants is the subject of a paper contributed by Mr. V. Lubimenko to the *Bulletin de l'Académie Impériale des Sciences*, St. Petersburg (No. 2, 1910). Experiments were made with twigs placed under bell-jars covered with thicknesses of white or black paper. In certain cases a diminution of light retarded development, in others it accelerated it; but in all cases complete darkness caused a marked retardation in the expansion of the buds. The author advances the opinion that light is necessary for the internal chemical changes which precede growth.

THE report on the Botanic Station, Experimental Plots and Agricultural School, Dominica, has recently been issued, and shows that much useful work has been done in distributing among planters crops likely to prove of commercial value or possessing striking features from an ornamental point of view. Much attention has been devoted to the manuring, cultivation, and general management of cacao; the requirements of the lime industry have been investigated, and some preliminary work has been done on the planting of rubber.

IN view of the enormous increase in the number of publications devoted to insect pests, it is becoming more and more necessary to have occasional summaries of the work done in a particular subject. We are therefore pleased to see that a "Bibliography of Sugar-cane Entomology," drawn up by Mr. G. W. Kirkaldy, has been issued as Bulletin No. 8 of the Hawaiian Sugar-Planters' Association. The list of papers seems to be very complete; indeed, the author tells us that a considerable number of apparently worthless notes have been included because of the difficulty of drawing a sharp line between what is and what is not useful. The bulletin is divided into two parts: a list of work, arranged under authors, and a preliminary list of the insects, spiders, &c., of the sugar-cane fields, with cross-references to the papers in the first part in which they are mentioned.

A RECENT issue (No. 30) of the *Transvaal Agricultural Journal* contains an article on the olive, urging that more attention should be paid to this crop. The olive was introduced into Cape Colony many years ago, but for some reason or other has never become very popular. It does not bear a paying crop until it is at least six or seven years old, and the oil has to compete with highly adulterated commercial products; but there is a good deal of land in the Transvaal that would give satisfactory crops either with or without irrigation, and one or two trial plantations are already in existence which promise to be successful. We have also received from the Transvaal Department of Agriculture some Farmers' Bulletins dealing with sunflower cultivation, prickly pear for stock food, and the cultivation and preparation of the calabash pipe gourd. The sunflower does not appear to be a very promising crop, as it is expensive to handle and is largely produced in Russia.

PROF. DOVE, of Göttingen, contributes a suggestive article on the aims and methods of commercial geography to Petermann's *Mitteilungen*. The paper deals with the use of the population unit in discussion, the limits of effective capacity of trade routes, the relations of topography and climate to trade, and similar matters, and subjects some of the methods in ordinary use to somewhat severe criticism.

A NEW map showing the distribution of thunderstorm frequency in central and northern Europe, by Dr. E. Alt, appears in Petermann's *Mitteilungen*. The smallest yearly frequency occurs in Cornwall, north-western Scotland, Norway, and the Arctic coast, where the average is under five. The region of most frequent thunderstorms—more than thirty a year—appears in northern Italy and the Carpathians.

FROM a catalogue issued by Spindler and Hoyer, of Göttingen, we see that ninety-six seismographs, designed by Prof. Wiechert, have recently been distributed in various parts of the world. One has been installed by the National Physical Laboratory at Eskdalemuir. The largest of these instruments carries a mass of 17,000 kilos., and the motion of the ground relatively to this is magnified 2200 times. There is, however, a 5 per cent. loss in consequence of the inertia and elasticity of the system of levers. The instrument costs 5000 marks.

BETWEEN July 1 and December 31, 1909, at Shide, in the Isle of Wight, 279 earthquakes were recorded. Each of these records is confirmed by corresponding observations at other observatories, whilst many of them are known to be the surviving efforts of earthquakes which were large at a distant origin. They are therefore of great importance. The instruments at Shide are of the type adopted by the British Association, recording on paper moving at a rate of 4 mm. per minute. During the same interval of time Hamburg recorded 123 shocks, Strassburg 64, and Laibach 42. These great differences in the number of records obtained at different stations appear to be almost entirely due to the type of instrument employed. Those which record on smoked paper are excellent for large disturbances, but fail to record movements which are small.

FROM Dr. Fielding H. Garrison we have received reprints of articles on "Josiah Willard Gibbs and his Relation to Modern Science" and "Physiology and the Second Law of Thermodynamics," which have appeared in the *Popular Science Monthly*, May–August, 1909, and the *New York Medical Journal* for September 25, 1909. The author is assistant librarian to the Army Medical Library at Washington. His writings, notably the one on Willard Gibbs, afford a lucid exposition of the principles of thermodynamics based on an intimate study of the large mass of literature which has centred round this important branch of physics. Most conspicuous, too, is Dr. Garrison's clear appreciation of the debt which experimental science owes to the late Prof. Gibbs for original work essentially mathematical in character. What mathematics can and must do for science, and, on the other hand, what it should never try to do, are points often ill understood, even by workers on physical science that have been trained on orthodox academic lines, and few people have presented the case so effectively as has been done by the army doctor who has written these papers.

A SERIES of experiments have been made recently at the Bureau of Standards at Washington to determine the proper source of light to combine with the mercury arc to produce the best imitation of average daylight, and the results are embodied in a paper by Mr. H. E. Ives in the November (1909) number of the Bulletin. It appears that of the ordinary lights, the Welsbach mantle, the carbon, the tungsten, and the tantalum filament glow lamps are all nearly complementary in colour to the mercury lamp, and have, therefore, only to be combined with the latter in suitable proportions to produce satisfactory imitations of daylight. The best proportions are 1 candle-power of mercury light to 0·57 candle-power of Welsbach light, 0·54 of tungsten, or 0·50 of carbon glow light. The watts per candle-power required are 0·80 for the tungsten and 1·4 for the carbon filament combinations respectively. Although the Welsbach cannot be compared in this way, the author finds from the cost of running that the Welsbach mercury combination compares closely with the tungsten mercury one in efficiency.

THE *Journal de Physique* for February contains a communication, made to the Société française de Physique by M. Charles Lallemand, on tides in the earth's crust (see NATURE, October 14, p. 457). After a description of the double horizontal pendulum of Hecker, the author explains how the diurnal tilting of the crust, due to the heating of the tropics, may be separated from the smaller semi-diurnal tilt due to the solar tide, and gives diagrams showing the extent of each as determined at Potsdam. The first has a semi-amplitude of the order 10–20 thousandths of a second of arc, the second 2–6 thousandths. Further investigation allows the lunar tide to be determined, and this is found to have a semi-amplitude of the order 10 thousandths. It is hoped by the help of still more sensitive apparatus to detect the half-monthly tide, which should have a semi-amplitude about half that of the semi-diurnal solar tide.

THE Bausch and Lomb Optical Co., 19 Thavies Inn, E.C., has afforded an opportunity to a representative of NATURE to examine the Balopticon lanterns which it has just produced and see a demonstration of their functions. The lanterns are designed for transparent or opaque projection, and they combine neatness with efficiency. The arc-lamps are of special design and of small dimensions, and the bodies of the lanterns are designed to suit the lamps, so that the lanterns, as a whole, are delightfully compact. The lamp-case is lined with asbestos, and the top has the form of a light-tight ventilator, securing a minimum heating effect during operation. The ventilating arrangement is really very satisfactory, and the whole mechanical construction is commendable. The lantern suffers, however, from the merits of its qualities, inasmuch as an ordinary arc-lamp cannot be used with it. Notwithstanding this, the Balopticon, which is made in various models, provides, at a reasonable price, a projection apparatus which is well designed and should be extensively used. An instructive pamphlet referring to the Balopticon lanterns is issued by the Bausch and Lomb Optical Co.

THE first volume in celebration of the jubilee of Prof. Arrhenius was noticed in NATURE of February 3. The second volume (*Zeitschrift für physikalische Chemie*, Band 70) has now been issued. It contains forty-five papers by chemists of every nationality. The attention of both supporters and opponents of Arrhenius's theory of electrolytic dissociation may be directed to the article by Mr. G. N. Lewis "On the Use and Abuse of the Ionic Theory."

VARIOUS articles of glassware for laboratory use, including beakers, retorts, boiling, Erlenmeyer, and Kjeldahl flasks, have been forwarded for inspection by Messrs. John J. Griffin and Sons, Ltd., of Kingsway, London, W.C. They are made from a new variety of laboratory glass now being produced by the Rhenish Glass Works, Cologne-Ehrenfeld. This glass is said to be equal to Jena ware as regards resistance to the action of water and of various chemical reagents, whilst having an appreciable advantage in price. The apparatus submitted, though perhaps a little heavier than usual, is well made, and satisfactory in lustre and general appearance. Its refractoriness towards the action of water, acids, and alkalies could, of course, only be proved by trial, but in this respect the behaviour of the glass is attested by certificates quoted, including one from the Physikalisch-Technische Reichsanstalt at Charlottenburg. After a preliminary treatment of the articles for three days, water at 18° C. acting during seven days extracted only 0·002 milligram of alkali (Na_2O) from each 100 sq. cm. of surface exposed, and in three hours at 80° only 0·009 milligram was removed. The material is therefore classed as "water-resisting" glass. Other tests adduced show the extent of the action exerted by boiling solutions of sulphuric acid, sodium carbonate, and sodium hydroxide upon the glass during specified periods, and also the effects of sudden change of temperature. The results go to show that the new glass is a very satisfactory material for chemical apparatus.

IN addition to the books referred to in "Forthcoming Books of Science" (NATURE, March 10), the following works are announced:—"Tomatoes and How to Grow Them," F. R. Castle; "Mushrooms and their Cultivation," T. W. Sanders; "Bees for Profit and Pleasure," H. Geary; "Window and Indoor Gardening," T. W. Sanders (*Collingridge*); "A Book about Sweet Peas," W. P. Wright; "Garden Guide," W. P. Wright (*Headley*); "Radio-chemistry," A. T. Cameron (*Dent*); "The History of Chemistry," vol. ii., Sir Edward Thorpe, C.B., F.R.S.; "Last Words on Evolution," E. Haeckel; "The Evolution of Man," E. Haeckel, translated by J. McCabe, 2 vols., new edition; "The Story of Creation," E. Clodd, new edition (*Watts*); "A Text-book of Nervous Diseases," Drs. W. A. Turner and T. G. Stewart; "The Practice of Surgery," W. G. Spencer and G. E. Gask; "The Malarial Fevers, Hæmoglobinuric Fever, and the Blood Protozoa of Man," Captain C. F. Craig (*Churchill*).

OUR ASTRONOMICAL COLUMN.

COMET 1910*a*.—A number of observations, with drawings and photographs, of comet 1910*a* are published in the March number of the *Bulletin de la Société astronomique de France*. Among others, M. Quénisset describes the observations made at the Juvisy Observatory, where photographs of the comet and its spectrum were taken, and drawings made, between January 21 and February 12.

A photograph taken on January 29 shows the secondary tail extending to some distance from the nucleus on the south side of the main tail, with which it formed an angle of about 25°; on this date the main tail was estimated to be longer than 62 million miles. The fan-shaped extension towards the sun is also shown, and extended to some 8′ from the nucleus, its northern edge showing the concave form discussed by M. Sola.

Comte de la Baume Pluvinel reports that the spectrograms show the nucleus sharply defined in the two principal radiations of the cyanogen band at λ 388, and an intense image of the comet was produced in the hydrocarbon band near λ 472. Between these, the nucleus and tail give a continuous spectrum which presents several condensations, the interpretation of which is still under investigation.

The observations made at the Lick Observatory are recorded in Bulletin No. 174, and show that considerable changes took place in the spectrum between January 19 and 31. The comet was first seen on January 19 as a fan-shaped cloud several times as bright as Venus at its maximum brilliancy, and spectroscopic observations showed the D lines bright, against a background of sky spectrum; D_2 was seen to be much stronger, and to extend further than D_1. The comet, having considerably decreased in brightness, could not be seen the next day, and a great storm prevented further observations until January 26. It was then seen that, in addition to the D lines, the regular cometary bands were present. On January 27 the same features were recorded, and an additional brightening was seen just to the right of D. A photograph of the spectrum showed a great similarity to the spectrum of comet 1907*d*, as photographed by Dr. Campbell, the continuous spectrum being relatively weak as compared with the bands. Observations made on January 31 showed that the D lines and the red condensation had disappeared, and that the spectrum of the tail was continuous, extending to a distance of 1° from the head.

On February 1 and 2 spectra were photographed with a prismatic camera, and show that the light of the tail is practically all within the visual region, extending towards the violet but a short distance beyond λ 467. Dr. Wright suggests that it may be due to sodium vapour rendered fluorescent by the intense sunlight; this assumption might also account for the faint band seen on the red side of the D lines.

Dr. Albrecht also made spectroscopic observations with a newly designed grating spectrograph of high dispersion attached to the 36-inch refractor. The resulting photographs, on January 27, show the D lines, D_1 being not more than one-third the intensity of D_2. The light from a sodium flame was employed as a comparison spectrum, and measures made of the radial velocity of the comet, which was found to be +66·1 km., and is believed to be trustworthy within 2 or 3 km. Dr. Albrecht suggests that such observations might be useful in determining the orbit of a comet in rare cases, such as the present, when it is difficult to determine accurate positions. Subsequent observations showed that between January 27 and 30 the intensity of the D lines must have decreased ten-fold.

Photographs taken by Messrs. Merrill and Oliver cover the period January 26 to February 1, and show the general changes and details well, but no sharp narrow streamers and bright knots or condensations are anywhere indicated.

In No. 610 of the *Astronomical Journal* Prof. Barnard reports that cloudy weather prevented photographs being taken at the Yerkes Observatory during the period of the comet's greatest brilliancy, except on January 21 and 24, when fair negatives were obtained. A photograph taken on February 3 shows the extension beyond the head, towards the sun, to be 12′ long. This extension is a prolongation of the southern edge of the main tail, and is shown on all three photographs taken on that date.

A further continuation of Dr. Kobold's ephemeris is given in No. 4393 of the *Astronomische Nachrichten*, and shows that the comet is still moving very slowly northwards through Pegasus, the position for March 17 being 22h. 27·6m., +16° 32′. An observation made by Herr Pechüle on March 6 gave corrections of 0s., +0·5′, and showed the magnitude to be about 9·5.

HALLEY'S COMET.—Numerous photographs of Halley's comet have been secured, at the Lick Observatory, with the Crossley reflector and other instruments. The negatives taken on December 11, 12, and 13, 1909, show the coma and faint traces of a cone-shaped tail; as the angle made by lines from the comet to the earth and sun, respectively, was, on that date, less than 2°, this indicates a fairly well-developed tail. A photograph secured by Mr. Olivier with the Crocker telescope on January 28 shows a tail nearly 1° long. On a negative taken with the Crossley reflector on February 4 a very fine, sharp, stellar nucleus, less than 5″ in diameter, is seen, and the tail appears as a narrow, sharply defined cone; but similar photographs secured on February 10 and 11 show an entirely different form of tail, the narrow quiescent cone having given way to a tail having several fine streamers radiating from the head; the two longest streamers are straight, and can be traced to a distance of 20′ from the head, while the most southerly one is curved. These changes are also shown on the photographs taken with other instruments, where the tail can be traced to a distance of 40′, and doubtless indicate a sudden burst of activity during the first week in February (Lick Observatory Bulletin, No. 174, p. 183).

PIDOUX'S COMET.—It now appears probable that the report of the discovery of a new comet at Geneva was a mistake. A plate exposed through clouds on February 20 showed a V-shaped nebulous form near Halley's comet, and before the identification of this object could be completed, the news arrived that a new comet, in the same position, had been discovered at Cardiff. A plate exposed on February 14, on the same region, showed no trace of the object, but a similar form was seen on the edge of a plate taken on February 16; but on a photograph taken at Heidelberg on February 10, which covers the region where, according to calculation, the alleged comet should then have appeared, there is no trace of any such object. As no control plate is available, the existence of the reported comet cannot be confirmed (*Astronomische Nachrichten*, No. 4392).

THE INTERNATIONAL AËRO AND MOTOR BOAT EXHIBITION.

THIS exhibition opened at Olympia on March 11, and will continue until March 19. The Society of Motor Manufacturers and Traders, Ltd., supported by the Aëro Club of the United Kingdom, are responsible for the organisation, and deserve commendation for the fine collection of machines on show. It will be remembered that the first exhibition of this kind, organised by the same society, was held last March. Great advances have been made in flying machines during the interval, and the fact that British makers do not intend to be left behind will be evident to anyone who visits Olympia this week. A pleasing feature of the present exhibition is the almost entire absence of "crank" ideas, especially in the full-size machines shown. Such are almost inevitable in any collection of models, but even the model section contains many fine examples of thoughtful design and skilful workmanship.

Monoplanes comprise by far the larger number of machines in the exhibition. Apart from any inherent advantages of this design, such as space occupied, convenience in dismounting and packing for transit, and lightness, there is no doubt that its popularity, both with makers and buyers, is owing to Blériot's flight across the Channel last summer. There are twenty monoplanes, nine biplanes, and one triplane, all of these being full-size machines. In addition, there are two balloons, a dirigible, and a large number of engines and accessories shown separately, as well as motor-boats and launches. In practically every case it is evident that the brains of a skilled engineer have been brought to bear on the design and construction.

Profiting by past experience in metal propellers and their dangers, most of the propellers shown are constructed of wood, built up so as to secure the grain everywhere running straight from tip to tip. A few makers are bracing the lattice girder forming the main frame in the monoplane type with wood in preference to piano wire, although the use of the latter for bracing is still general. In several cases piano wire has been abandoned for bracing the wings, the preferable material for this purpose being light stranded wire rope and flat steel ribbon.

The engines are generally of the fixed cylinder type, although a few rotary engines may be observed. Water-cooling is more usual than air-cooling. In biplanes the engine and propeller are usually situated behind the pilot; in monoplanes these are generally in front of the seat, although in the case of the Petre monoplane the propeller is at the extreme rear of the machine, and is driven by a tubular shaft from the engine which is placed behind the pilot; but few makers warp or alter the inclination of the main wings for steering or for stability; in most cases ailerons are fitted to biplanes, and in the monoplane type the tails are made movable for vertical and horizontal control. Practically all wings are double surfaced. More firms are paying attention to the matter of reducing the number of levers required for control. For example, in the Humber machines all control is effected by a single steering wheel mounted on a pillar which can swing, and the steering-wheel spindle is capable of axial as well as rotary motion in the pillar. These movements independently operate all the control; there are no foot or hand levers.

It is exceedingly gratifying to notice the large number of British-built aëroplanes; some sixteen of the total machines on show have been built entirely in this country; of the engines shown separately, by far the greater number are British-built. There is no doubt that a great awakening to the possibilities has taken place among our engineers, and that no efforts have been spared during the past autumn and winter to develop the manufacture of flying machines. Many of these British machines have been tested, and when we possess, as no doubt we shall before the coming summer is over, a reasonable number of British pilots having experience with the machines, we shall be able to regard this country as no longer behind in this important industry. The limitations of space forbid us noticing particularly any but a very few of the machines in the exhibition.

Of machines shown by members of the Royal Aëro Club, one of the most interesting is a Short Wright biplane, the first of its kind built in England, and belonging to the Hon. C. S. Rolls. This machine has flown about 100 miles, and has won many prizes. In general design it closely resembles the machines used by the Wright Brothers. There are twin screws, chain driven; the dimensions are 40 feet by 28 feet by 8 feet. Another Short biplane is shown belonging to Mr. J. T. C. Moore-Brabazon. This machine measures 45 feet in breadth, 28 feet in length, and $8\frac{1}{2}$ feet in height. The weight of machine complete, with aviator and in flying order, is 1500 lb.; the actual lifting surface is 450 square feet. The machine is fitted with Short's patent front elevators and balancing planes, and has their system of trussed girder skids. Twin propellers are fitted running in the same direction; this is the first time this principle has been adopted, and has proved to be very successful. A front vertical rudder has been substituted for one in the rear for directional steering. The speed is about 48 miles per hour, and the machine has made a large number of flights, that of March 1, 1910, being of 32 minutes' duration in covering a distance of about 25 miles. This machine won the 1000*l.* prize (*Daily Mail*) for the circular mile, all-British made. A monoplane built by Messrs. Holland and Holland, and belonging to Mr. B. Nicolson, is also shown.

Messrs. Short Bros. also show a new biplane built for the Hon. C. S. Rolls. The engine is a Green four-cylinder, 105 mm. by 120 mm. bore, giving 38 horse-power at 1200 revolutions per minute. The lifting surface is 270 square feet, and the weight complete is 700 lb. In the annexe is a Sommer biplane, also owned by the Hon. C. S. Rolls. This machine is fitted with a Gnome engine (rotary). Messrs. Humber, of Coventry, show three monoplanes of their own manufacture. The workmanship and finish of these machines are beyond reproach. Messrs. A. V. Roe and Co. are represented by a triplane of all-British make. This machine is 20 feet long by 20 feet span, and is 9 feet high. The main planes, and also the tail, consist of three planes arranged one over the other, the total supporting surface being 320 square feet. The weight without motor and fittings is 150 lb. All the planes are under control, so that the angle of attack can be adjusted from the steering wheel, and the main planes can be warped. The seats for the pilot and one passenger are behind the main planes, and the engine and propeller in front. Machines of this type have made frequent flights with a motor of 9 horse-power only, and start quickly, often in twenty yards.

Messrs. Blériot have three of their models No. XI. cross-Channel type of monoplane in the exhibition. These machines are fitted with a three-cylinder Anzani motor giving about 25 horse-power; bore, 105 mm.; stroke, 130 mm.; weight in full running trim, 60 kilograms. The propeller is made of layers of French walnut, of diameter 2·1 metres, and weighs $4\frac{1}{2}$ kilograms only; its speed is from 1200 to 1700 revolutions per minute. The monoplane measures about $25\frac{1}{2}$ feet across the wings, and is about 26 feet long; the sustaining surface is about 14 square metres. The total weight of the machine is about 300 kilograms, including the pilot and fuel for a two-hours' run. The speed is about 68 kilometres per hour, and the machine can lift and sustain in flight about 22 kilograms per square metre of supporting surface, *i.e.* about 5 lb. per square foot.

Messrs. A. Darracq and Co. show the latest type of Farman biplane. The length is 39 feet, span $32\frac{1}{2}$ feet, height 11 feet 4 inches. The supporting surface is 480 square feet, and the weight without engine is 1050 lb. A Chauvière propeller $8\frac{1}{2}$ feet in diameter is placed at the rear of the main planes. The motor on the machine shown is a 50 horse-power Darracq four-cylinder horizontally opposed; bore, 130 mm.; stroke, 120 mm. The cylinders are water-cooled, and the weight, with oil and water pumps and carburettor, is 242 lb. The machines are made under the personal supervision of Mr. Henry Farman at the Châlons Camp, in France.

The Demoiselle machine of Mr. Santos-Dumont shown at the Clement-Bayard stand attracted great attention. This is claimed to be the smallest, lightest, and fastest aëroplane in the world. The length is about 20 feet, width about 18 feet, supporting surface 110 square feet, weight 242 lb. with a two-cylinder water-cooled motor. The radiators are arranged close up under the wings, one on each side of the main frame. The horizontal and vertical planes forming the tail are rigid as regards one another, but the tail can turn as a whole on vertical and horizontal axes for controlling directional and elevating steering. Another interesting exhibit at this stand is the engineer's cab of the dirigible Clement-Bayard. We noted in the engines shown at this stand the care which had been taken to lock all nuts and fastenings so as to prevent them becoming loose.

A Grégoire Gyp monoplane shown by the Fiat Motors, Ltd., did not arrive until ten o'clock on Friday evening. It is interesting to know that the machine was ready for exhibition shortly after eleven o'clock on the same night, showing the ease with which the monoplane type can be erected. The Phœnix Radial Rotary Motor Co., Ltd., show part of a twelve-cylinder rotary engine under construction for Mr. Cody.

The Motor Supply Co., Ltd., show an Avis type monoplane built by the Scottish Aëroplane Syndicate of London. This machine is entirely of British make, except the 30 horse-power Anzani engine. The machine is of the non-lifting tail type, 27 feet wide and 27 feet long. The main planes have a surface of 160 square feet. The weight without motor is 280 lb.; the weight of the motor complete is 150 lb. Messrs. Mulliner, of Long Acre, show a monoplane of entirely British make. This machine has an improved system of warping the trailing edge, combined with the action of a non-lifting type of elevator and a rudder at the rear. Messrs. Mann and Overtons, Ltd., of Pimlico, show a monoplane of the Santos-Dumont type. An English-built monoplane is shown by Messrs. R. Lascelles and Co., Ltd., and an all-British biplane by

Messrs. George and Jobling; both these machines possess interesting features in the matter of control. There are also monoplanes by the Star Engineering Co., Ltd., of Wolverhampton, and by Handley Page, Ltd., of London.

It is quite impossible to deal adequately with all the points of interest in the exhibition. That its success is assured, and that its effects will be far-reaching, are evidenced by the large numbers of visitors, most of whom appeared to be keenly interested and full of inquiries.

EXPLORATIONS IN THE GLACIER TRIBUTARIES OF THE SHAYOK RIVER, KASHMIR TERRITORY.

IN the *Times* of December 21, 1909, reference was made to certain discoveries by a party consisting of Dr. E. G. Longstaff, Dr. A. Neve, and Lieut. A. M. Slingsby in the Kashmir Himalaya. The *Geographical Journal* of November, 1909, also had an article, based upon an account of the tour, written by Dr. Neve in the *Times of India* of September 4. A few remarks concerning the addition to Himalayan geography referred to in these communications may be of interest.

The topography of this part of Baltistan requires explanation; if the atlas sheets are examined, it will be seen how very few trigonometrical points are to be found east of longitude 77°. They are much fewer than in the portion of Baltistan I had to survey on the Lower Shayok and Indus, and the branches of the Shigar tributary of the latter river. The difficulties of penetrating into these out-of-the-way valleys were very great, and it was almost a superhuman task for Mr. Ryall and other assistants to produce, in the limited time given them, a better or more accurate idea of its geographical features. Very few of the glaciers were followed up, or can be followed up, so their sources were merely sketched in by eye from a distance. Very many tributaries are inaccessible, either from their rocky, wall-like sides, or the stream being too deep and rapid to ford, there being no bridges, or the means of making them. Thus the topography can only be classed as rough reconnaissance. The Saichar valley and its glacier was not ascended far, if at all, and even the distance and size Mr. Ryall assigned to it some twelve miles N.W. from Saichar would in nature appear to be its total length; it probably has a bend, and if straight a distant ice fall, or a local narrowing might give the appearance of a watershed. I have not heard of Mr. Ryall for very many years; if he is still living he would be able to tell us whether he ascended the glacier to any distance. His field book, if it is to be found, would give much information as to where he went. There would be his boiling-point observations, and the notes he made in it.

There can be no absolute accuracy in the topography at the head of the Kondus Valley, south-east of Snowy Peak K. This valley, I would point out, is well worthy of further exploration, because it is possible some high point on its eastern side could be reached from which a view would be obtained of the higher portion of the newly-discovered Terim Glacier and the snowy range which bounds it on the north-eastward. Concerning the Terim Glacier extension of the Saichar, the discovery alters the position of the main range, which may be taken as fairly well laid down up to lat. 25° 30′, long. 77° 30′. North of lat. 35° 30′ up to about lat. 35° 45′ and long. 77° has certainly to be mapped. This is some forty-five to fifty miles in length, and lies fifteen miles or more further to the north and eastward. It is to be hoped that Colonel Long, the present Surveyor-General of India, will see his way to depute one or two of his best officers to extend the triangulation, fix more points, and accurately lay down this corner on a plane table—an attractive, delightful summer's work for someone.

That very high peaks in this corner, lying to the east of K2 and Gusherbrum, escaped the view of the triangulators when they were observing at the principal stations of the Indus River and Changchenmo series is not surprising. The high mass between the head of the Nubra River and the Shayok, 20,000 to 22,000 feet, would hide much. From trigonometrical stations east of Leh, the same portion of the main water parting is shut out by another lofty mass 22,000 to 25,000 feet, dominating the Shayok Valley on its northern side.

The Shayok series was a very short one, the stations of observation did not extend to lat. 35°, and from the two highest stations, Ajanliung, 19,903 feet, and Telthep, 19,705 feet, overlooking and south of the Shayok Valley, peaks at the head of the Saichar Glacier would not be visible owing to the intervening mountain masses.

A point of interest is the great length of the Terim Glacier, estimated at forty-four miles, next its position and direction, in connection with the trend of the ranges in Ladak and the mountain area both to the eastward and westward. This great glacier, as described, would appear to occupy a blank on the map, and, like a piece of a puzzle, exactly where it might be expected to fit in. This the topography at the head of the Saichar Glacier and the line of the main water parting did not previously indicate on the atlas sheet.

A valuable compilation was published in 1907, viz. "A Sketch of the Geography and Geology of the Himalaya Mountains and Thibet," by Colonel S. G. Burrard, R.E., F.R.S., superintendent Trigonometrical Survey, and H. H. Hayden, superintendent Geological Survey of India. In 1883—presidential address, Geographical Section, British Association—I made an attempt to bring the remarkable parallelism of the mountain ranges into some sort of systematic sequence from the plains up to the loftiest parts of the Himalayan chain. Correctness in detail was not to be expected over such an extended area, yet it is some satisfaction to find the general principle underlying my plans and sections has been accepted by officers of the Trigonometrical and Geological Surveys. My Shayok Kailas range they call the Kailas; for my Mustakh axis, which I considered one of the most important, they adopt that of Karakoram; but I am now inclined to think, from what Dr. Longstaff reports, that yet another well-marked elevated range is indicated by an extension of Younghusband's Aghils, on the northern side of the Oprang Valley, continued to Longstaff's new peak, 27,610 feet, about long. 77° and lat. 35° 30′ (*vide Geographical Journal*, January, 1910, p. 65). I am doubtful if this assigned position is correct, for on the atlas sheet it is close to the head of the glacier called Sherpi Gang, in the Kondus Valley. The position long. 77° 20′ and lat. 35° 40′ given in the *Times of India* would appear to fit in best with the general account. The Karakoram pass and watershed lie some forty miles to the north-east of the Saichar Glacier, and must therefore fall on a still more northern axis of elevation, running in the direction of the Lingzhithang plain, and quite distinct from my Mustakh one.

From Leh the direction of the Ladak axis or range is indisputably to the south-east, and it leaves the Pangkong Lake and Rudok well to the north, but the west and east wrinkling exhibited in the ranges much further to the north has not been so definitely established owing to the absence at many points of geological data to link them up; this is particularly the case with the Karakoram pass and the country north of the Changchenmo range.

The topography of this area leads me to notice what is written in the above-mentioned work by Colonel Burrard and Dr. Hayden, part ii., p. 100:—"Even the great Karakoram peaks themselves seem to follow two alignments. The Masherbrum peaks and peak 63 or K12 (table v. of part i.) surmount a ridge parallel to that on which the peaks of K2 and Gusherbrum stand, and at a distance of ten miles from it." This feature can thus be explained.

The Masherbrum ridge westward from K6, 25,119 feet, the peak which the Duke of the Abruzzi ascended to 24,583 feet last summer, represents, together with the Mustakh Pass granite axis, one main broad line of elevation. The Baltoro Valley occupies the trough scoured by its glacier along the strike and junction of the stratified rocks of the Masherbrum side, which originally lay up against the granite, and may very possibly have been once continuous over it. The southern Masherbrum ridge is, in fact, only a secondary feature, the result of denudation.

I cannot say for certain what K2 is composed of—probably not granite, more likely of the metamorphic and stratified series coming in on the north of the axis. This may be explained in more detail.

The stratified rocks, schists and slates, limestones and sandstones, a series of enormous thickness, composing the

Panjal and Zanskar systems, occupy, as it were, ellipsoid basins or long troughs in the granite, and crushed up against it. Lines of drainage often follow the line of junction, breaking through the basal granitoid rock at certain points. We find a very instructive section on the Panmah Glacier, further west, which has cut its way down through the main granite axis, having here a breadth of ten miles or so. Further up the glacier, at Drenmung, where it bends round to the north-west, this main source, the Nobundi Sobundi Glacier, lies parallel to the line of the main water parting between the Indus drainage and the Oprang Valley. The broad river of ice is bounded on the south-west by the granite, on the north-east by a great series of stratified rocks forming the elevated main range for many miles and dipping to the northward. The breadth of granite continues thence for fifteen miles south-east, and then another twenty-five miles east towards Gusherbrum, and comes in, in the Baltoro Valley, forming the wonderful spurs and peaks of its northern side. Across the breadth of the glacier, moraine after moraine, for some three miles, the precipitous southern flank of the Masherbrum Ridge rises, all of stratified rocks, and Gusherbrum, at the eastern end, appeared to be of the same series, but closer to their junction with the granite, and vertical.

At Gusherbrum, K6 and K, a slight change in the strike of the whole mountain mass takes place. The head of the Terim Glacier, according to Dr. Longstaff, extends up to Gusherbrum, and he has proved that this glacier is the head of Ryall's Saichar Glacier, which, so far as it is shown on the atlas sheet, has a direction N.W. to S.E., the line of valley trough being continued eastward in the Nubra to the junction of that river with the Shayok. There seems a probability, arising from the interesting fact mentioned by Dr. Neve of granite rocks on the south of the Terim Glacier, stratified rocks on the north, that the former correspond to those north of the Baltoro Valley, and that the stratified series from near Gusherbrum continues east and forms the water parting between the Oprang Valley and the Terim Glacier. If such be the case we have a continuous strike of granite along the Nubra River to Changlung, *vide* Lydekker's map, Memoirs of the Geological Survey, vol. xxii., thence to the Marse mik La, which I know, to Nyak Tso of the Pangkong, and so on towards the Aling Kangri range, leading into Dr. Sven Hedin's Trans-Himalaya.

To return to the Masherbrum ridge, this finds its counterpart further west, and is represented by those remarkable sharp-pointed peaks, No. 11, B16, and B15, on the east side of the Biafo Glacier. This great glacier and the Hisper, indicating the position of this Mustakh axis as far as Hunza Nagayr, is truly one of the most striking physical features to be met with in the Himalayan chain.

H. H. GODWIN-AUSTEN.

BOTANICAL PAPERS FROM CAMBRIDGE.[1]

THE six papers referred to below are the work of members of the vigorous school of botany (including palæobotany) which now flourishes at Cambridge.

(1) Miss Stephens's investigation, begun in the botanical laboratory of the South African College at the suggestion of Prof. Pearson, is of considerable importance. The Penæaceæ are a small order of heath-like shrubs, allied to the Daphne family, and limited to the south-western region of Cape Colony. Out of the five genera, three, represented by six species, have been examined, and have all been found to agree in the essential points.

The ovary has four carpels and four loculi, each of which contains from two to four anatropous ovules with two integuments. The embryo-sac is derived directly, without intermediate cell-formation, from its mother cell; hence the reduction-division takes place in the nucleus of the embryo-sac. Four nuclei are first formed, and then each of these divides into two. The four pairs of nuclei are usually found lying cross-wise, one pair at each end of the sac and the other two at the sides. Each pair then divides again; four free nuclei, one from each group, fuse to form the primary endosperm-nucleus, while the three remaining cells in the four groups assume more or less the arrangement and appearance of an egg-apparatus. Thus the mature embryo-sac normally contains four peripheral groups of cells, each group resembling an egg-apparatus, and four nuclei in the middle, fusing to form the endosperm-nucleus; occasional variations from the prevailing arrangement were observed. Usually it is the ovum belonging to the group nearest the micropyle which is fertilised. In the case of this apical group fertilisation has been repeatedly observed; there is no evidence that parthenogenesis occurs. The interesting question whether the quadruple endosperm nucleus is fertilised, as in typical angiosperms, by one of the male nuclei, has not yet been determined. The embryo is remarkable for the absence of a suspensor, the small development of the cotyledons in comparison with the bulky hypocotyl, and the absence of a root-cap up to the time when the seed is ripe.

The significance of the peculiar type of embryo-sac in this order (only paralleled, as yet, by a species of Euphorbia) is fully discussed. The interest of the question is enhanced by the consideration that the Penæaceæ appear to be a dying-out family, as suggested by their limited distribution, the non-germination of the seeds in culture, and the extreme rarity of seedlings in nature. The author sums up her conclusions as follows:—"This embryo-sac is probably to be regarded as a derived form, with all four megaspores included in its development, rather than as a primitive one. . . ." "It is suggested that in either case its endosperm is formed, like that of *Welwitschia*, by a fusion of potential gametes, all the nuclei in the sac being looked upon as potential or reduced gametes."

(2) The genus Saxegothæa is represented by a single species, a small, yew-like tree growing in wet woods on the upper slopes of the Chilian Andes. Mr. Stiles has made a detailed investigation of the anatomy of both vegetative and reproductive organs, and confirms the position usually assigned to the genus as a member of the Podocarpeæ, a tribe of taxoid conifers. At the same time, he finds many points in common between Saxegothæa and the Araucarieæ. He unnecessarily weakens his case by the statement that "Saxegothæa differs from the Araucarieæ in having the ovule inverted" (p. 218); the ovule is, of course, inverted in both groups alike.

The author concludes:—"Thus it would seem probable, as Lindley said in his first description of the plant [1851], that Saxegothæa is a transition of a remarkable kind between the Pinaceæ and the Taxaceæ." The conclusion is interesting, as it supports the view that the Coniferales are essentially a monophyletic stock.

(3) The authors, Messrs. South and Compton, were so fortunate as to have at their disposal a plant of the Mexican cycad, *Dioon edule*, no less than 120 years old; it had spent thirty years of its life in the Botanic Garden at Manchester. In so old a plant—65 cm. in height and 80 cm. in girth—the narrowness of the vascular zone was remarkable; it was only ½ cm. in thickness, one-fifteenth of the radius of the stem; this poor development of the conducting system is accounted for by the small number of leaves functional at one time, the slow rate of growth, and the xerophilous habit. The structure of the stem is normal as in Stangeria, showing none of the vascular anomalies characteristic of some other cycadaceous genera. Within the stem two dome-like systems of internal strands, running out into the withered peduncles of bygone cones, were observed. The authors accept Count Solms-Laubach's interpretation that the growth of the stem is sympodial; each cone terminates the main axis, while the stem is continued by one of a pair of opposite buds. The presence of *two* such buds (one being abortive) is a new

[1] (1) The Embryo-sac and Embryo of certain Penæaceæ. By E. L. Stephens. (*Annals of Botany*, vol. xxiii., pp. 363–78; pl. xxv. and xxvi., July, 1909.)
(2) The Anatomy of *Saxegothaea conspicua*, Lindl. By W. Stiles. (*New Phytologist*, vol. vii., pp. 209–22; figs. 28–34, November, 1908.)
(3) Notes on the Anatomy of *Dioon edule*, Lindl. By F. W. South and R. H. Compton. (*Ibid.*, pp. 222–29; figs. 35–40, November, 1908.)
(4) On a Cone of *Calamostachys Binneyana*, Carruthers, attached to a Leafy Shoot. By H. Hamshaw Thomas. (*Ibid.*, vol. viii., pp. 249–60; pl. i. and figs. 31, 32, July, 1909.)
(5) The Morphology and Anatomy of *Utricularia brachiata*, Oliver. By R. H. Compton. (*Ibid.*, pp. 117–30; figs. 6–12, April, 1909.)
(6) On an Abnormal Gynæceum in *Stachys sylvatica*, Linn. By A. W. Bartlett. (*Ibid.*, pp. 138–42; figs. 16, 17, April, 1909.)

observation of the authors', and is interesting from the analogy with the early Mesozoic genus Anomozamites, in which each fructification is in a terminal position in the fork between two vegetative branches.

The anatomy of the peduncle agrees with that in Stangeria, centripetal xylem occurring in the upper part, while small, blind-ending bundles, often of concentric structure, are present in the basal region.

Nodules, perhaps comparable to those of the Leguminosæ, occur on the roots. The authors regard the sympodial organisation of Dioon and Stangeria as primitive, and hold that the monopodial growth of the trunk observed by Prof. Pearson in Encephalartos is clearly a later development, and connected with the production of several cones simultaneously.

(4) Though for many years past no one has doubted that the fossil cones grouped under Calamostachys were the fructifications of calamites, the direct proof of continuity has so far been lacking in the case of those specimens which, at the same time, show the internal structure preserved. In this memoir Mr. Thomas records the discovery of the well-known petrified fructification *Calamostachys Binneyana* in connection with the vegetative organs of the plant to which it belonged. He has also made some interesting incidental observations—the probable presence, below the lowest whorl of bracts, of a disc comparable to the annulus of Equisetum, the presence of hairs (rare in this family) on the axis, and the close agreement in structure between the bracts and the vegetative leaves. The author has also observed impressions of cones and leafy shoots, which he refers to the same species with the petrified specimens, identifying both with the *Paracalamostachys Williamsoni* of Weiss and the *Asterophyllites* (*Calamocladus*) *grandis* of Sternberg. He suggests, with good reason, that the name *Calamostachys Binneyana*, hitherto used for the structural specimens, may represent a type rather than a species. In discussing the morphological questions involved, the author rightly emphasises the homology between bracts and foliage leaves, so clearly brought out in his specimens.

(5) *Utricularia brachiata* is a small species from the Sikkim Himalaya discovered by Sir Joseph Hooker; it grows, at an altitude of about 11,000 feet, on the trunks of *Abies Webbiana*, among moss. The plant consists of a flowering stem two or three inches high, a few reniform leaves, and several slender runners bearing tiny bladder-traps and tubers. The point of main interest, as in other species, is the morphology of the runners in relation to that of the leaves. The simple view that the "leaves" are phyllomes and the runners caulomes is rejected, on account of the innumerable transitions between the two, and the fact that the bladders are found indifferently on both. The theory that the runners are specialised leaves has been strongly maintained by Goebel, but the author, Mr. Compton, favours the alternative interpretation, advocated by the younger Schimper, that the runners are of the nature of stems, and that the "leaves" have been derived from similar organs by a process of flattening—that they are, in fact, phylloclades. The question is one of much difficulty; the author puts his case well, but we take exception to the argument that his interpretation "is without the theoretical demerit of the contrary view, in that it does not tend towards an abolition of morphological categories." The question as to the modifications that may have taken place in the organs of the genus Utricularia must surely be decided without reference to the convenience of the theoretical morphologist.

(6) Mr. Bartlett's little paper is a description of two flowering shoots of the common woundwort, found at Medstead, in Hampshire, which showed certain floral abnormalities, increasing in degree towards the apex of the shoot. In the extreme cases the pistil was represented by two hairy, foliaceous carpels, usually united by their edges below, and bearing abortive ovules. This teratological condition confirms the conclusion, based on development, that the pistil of Labiatæ is really bicarpellary, though the ovary is quadrilocular. The floral axis produced at its apex, within the modified ovary, one or more flower-buds—a case of Masters's "median floral prolification."

D. H. S.

THE PRODUCTION OF BLACKWATER FEVER.[1]

DRS. WAKELIN BARRATT and Warrington Yorke have pieced together the result of their investigations, in the form of a report, undertaken for the blackwater fever expedition to Nyasaland. The object of the work was to determine how blackwater fever is produced; in brief, it may be stated that the authors have failed to accomplish this object. Incidentally, the work was intended to throw light on many of the uncertainties connected with the fever, and in this respect they have succeeded.

In simple language, blackwater fever is a fever which occurs in persons who have been treated with quinine, usually for malaria, and the clinical connection between the fever and the quinine has been placed beyond dispute. The authors, after studying the processes of the dissolving up of red blood corpuscles under a large variety of conditions, adduce ample evidence to show that the alkaloid quinine can hæmolyse red blood cells, but that a direct action of the alkaloid in the body is excluded, because the concentration of the quinine in the blood plasma of persons under treatment for malaria is utterly insufficient to produce an ascertainable amount of hæmolysis.

Since quinine plays a part in producing this peculiar condition, but does not cause it directly, it was necessary to look farther afield for other ætiological factors. The authors have investigated the condition of the plasma itself, since in another disease, in which dissolved blood corpuscles are seen, the hæmolysis has been proved to be due to a substance in the serum known as hæmolysin. No trace of such a substance could be found in the serum of blackwater-fever patients. They leave this riddle unsolved, and turn to the question of the situation in which the hæmoglobin is set free. Proof appears to have been found that the site is the blood itself, and not the kidneys or urine, as had been supposed. Another fact which has been brought to light by the authors is that the only change which occurs in the kidneys in uncomplicated cases of the fever is the appearance of a brownish material placed in the lumen of the renal tubules. No degeneration or other indications of pathological conditions are to be found.

Various other points are dealt with, and the reading of the work is materially assisted by the publication of summaries at the termination of each chapter. The theoretical reasoning is well carried out, and the work, while failing to solve a difficult problem, certainly illuminates many contributory factors in the production of blackwater fever.

H. W. Armit.

THE ORGANISATION OF TECHNICAL EDUCATION.[2]

THE position of higher education has altered immensely in the last ten years since I ceased to be intimately connected with teaching. In the first place, the number of agencies engaged in the work has multiplied, the number of students they attract has grown, and the funds at their disposal are greatly larger. At that time there were two universities in England, besides the old foundations of Oxford, Cambridge, and Durham—London University, a purely examining body, and the Victoria University at Manchester, uniting the three colleges in Manchester, Liverpool, and Leeds. Now, if we may reckon Newcastle in addition to Durham, there are seven, each well equipped, and with a staff of professors competent and anxious to advance knowledge and to train their students for the duties of life.

But, besides this, there is in almost every important town a technical school or college supported by municipal funds, in two cases at least outside London an integral part of the university, everywhere doing work which must be done if we are to maintain our position in the world.

1 "An Investigation into the Mechanism of Production of Blackwater." By Dr. J. O. Wakelin Barratt and Dr. Warrington Yorke. (Being the Report of the Blackwater Fever Expedition to Nyasaland of the Liverpool School of Tropical Medicine, 1907–9.) *Annals of Tropical Medicine and Parasitology*, series T.M., vol. iii., No. 1, October. Pp. 256; with numerous illustrations and tables, &c. (Liverpool: University Press; London: Constable and Co., Ltd., 1909.) Price 10s. 6d.

2 From the presidential address delivered to the Association of Technical Institutions on February 11 by Dr. R. T. Glazebrook, F.R.S.

I do not mean that these technical colleges are all new since 1899; most of them, possibly all, were in existence before that time, but their importance is now more fully realised, and the magnitude of their task more completely grasped, by those who are responsible for their maintenance and progress.

Turning to London, we have the University with its colleges, University College, King's College, and the East London College, struggling to realise under no small difficulties the ideal of a great teaching university, and doing it with increasing success; the Imperial Technical College, with its constituent parts; the Royal College of Science; the Royal School of Mines; and the City and Guilds College, which has just started with high aims on its difficult task; and the numerous technical colleges too many to mention, some of them old institutions inspired to new endeavours by the wise action of the Charity Commissioners, the generosity of city companies, the vivifying influence of the whisky money, or the foresight of the education authority for the county.

A list containing the names of these institutions throughout the country, showing the funds administered on their behalf, their staff of teachers, and their roll of students, would prove a formidable document, and if the list were compared with a similar one drawn up ten or fifteen years ago the amount of progress would be obvious. I am aware, of course, that if we compared it with a similar list drawn up for Germany or America, our numbers and resources would appear but small.

I do not direct attention to our growth in any spirit of self-glorification or with any view to suggest that we ought to be satisfied, but rather that you who are so well qualified to advise and to judge may take stock of the position, may ask yourselves whether your efforts are in all cases being well and wisely directed, what ought to be your aims, and what your own position relative to the other agencies around which have the same general object in view.

This is, I take it, the more necessary because of the probable large influx of additional work with which in the course of a few years educational authorities in all parts of the country will probably be called upon to deal, while here in London the need for some general consideration is the more urgent because of the work which the Royal Commissioners for the University of London are now engaged upon.

What are the aims which we whose work lies mainly with the technical institutions of the country have to set before ourselves? What is our position in the scheme of education which is gradually being evolved?

Now there are two sets of individuals, for each of which a somewhat different course of training is needed, those who are to be leaders in industrial pursuits and those who will ever remain among the rank and file. While it should always be possible for the workman to rise to the rank of leader—and your scheme of education must give full opportunity for this—the methods of a trade school aimed chiefly at giving to the workers in its district that fuller knowledge which makes their labour skilled must clearly differ from those of a college designed to give the highest technical training to those who are to lead and guide the workers.

M. Leduc, in a recent paper published in the *Bulletin de la Société pour l'Industrie nationale*—the Society of Arts of France—directs attention to the four-fold division of German instruction in technological science:—

(1) The comprehensive training which is to turn out the future captains and leaders of industry.

(2) The provision for putting trustworthy information on technological matters at the disposal of traders.

(3) Central institutions established for the scientific and practical study of special industries, and

(4) Local technical schools adapted to the special needs of particular localities.

In Germany, as we know, the great technical institutions have developed almost independently of the ancient universities.

The term university was, we are told, in the Middle Ages used to denote any community or corporation regarded under its collective aspect, but finally it came to mean a community of teachers and scholars whose corporate existence had been recognised and sanctioned by civil or by ecclesiastical authority, or by both. In its earliest stage it was probably a scholastic guild, a spontaneous combination of teachers and scholars formed on the model of the trades guilds or guilds of aliens, in great measure for mutual protection. In still earlier days learning flourished mainly, if not entirely, in the monasteries and cloisters, and the earlier universities took their rise in the endeavour to provide instruction beyond the range of the monastic schools. For the most part they were organised under the four faculties of theology, law, medicine and philosophy, or the arts, and they retained this constitution until the last century.

In Germany the activity and importance of the universities dates from the time after Jena, 1806, when, as we were reminded by Sir Norman Lockyer in his presidential address to the British Association in 1903, King Frederick William III. and his counsellors, among them Wilhelm von Humboldt, founded the University of Berlin "to supply the loss of territory by intellectual effort." In the main, however, it was founded on the ancient lines, and when later on in the century the problems of the application of science to industry had to be faced, and the technical high schools came into existence, they were developed independently of the universities.

By 1903 the separation from the universities had become definite. In Prussia the Emperor had recognised it by giving certain of the great schools the right to grant the degree of Doctor of Engineering, thus putting them on an equality with the universities, and by admitting the principals to the Prussian House of Lords, giving them the title of His Magnificence.

Now there are in Germany ten of these technical universities, at Dantzig, Berlin (Charlottenburg), Aix, Hanover, Munich, Carlsruhe, Dresden, Stuttgart, Darmstadt, and Brunswick, all over the length and breadth of the land, with nearly 12,000 fully qualified day students between them, and more than 2000 in addition whose qualifications are not complete. Last year 1668 diplomas were granted, and of those who received the diploma 130 took the degree of Doctor of Engineering.

The age at which these students begin their work is from eighteen to nineteen years, and the "matriculation for fully qualified students at German technical universities is the completion of the full nine years' secondary-school course at a classical, semi-classical, or modern secondary school." Besides these, there are the twenty older universities, with 48,000 students, of which a large number study chemistry and, to use a Cambridge official phrase, "other branches of physics." The students work for four years, usually after a minimum period of one year in works, and the aim of the institutions is to train experts, inventors, high technical State and municipal officials, captains of industry, owners of great works, professors, secondary teachers, engineers, architects, chemists, &c.

Besides these ten technical universities, there are special engineering and other technical schools for the training of owners and managers of small works, foremen, clerks of works, surveyors, draughtsmen, and the like.

Now I have not referred to this merely to mark our own deficiencies, but rather to afford some guidance as to the lines along which we are to develop. Are we to look forward to the growth of technical universities in each town arising naturally out of the colleges with which we are connected, but independent of, and at the same time rivals of, the universities which in many cases exist already alongside our own colleges?

The answer to this question must, I think, be in the negative, with possibly one or two exceptions—we will put aside, for the present, London and the two ancient universities—it would, I think, be suicidal to suggest that in Manchester or Birmingham, Leeds or Liverpool, there should be two degree-giving bodies, one connected with the arts, literature, and pure science, the other with those applications of science on which industry depends; and for this reason, among others. The universities of England are modern creations animated by modern ideas, and controlled by men whose main endeavour is to bring home to the mass of their countrymen the blessings of knowledge. The seclusion of the mediæval cloister, the quiet of the monastery, or even of the courts and quadrangles by the Isis and the Cam are not for them. They are

placed amid the busy haunts of commerce, close to the foundry and the workshop, and their students seek to draw from ancient learning and from modern research alike those lessons of truth, those unerring laws of nature in accordance with which we must progress if our country is to remain great, to hold the premier place among the nations.

These universities will do for us what the technical high schools have done for Germany.

Let me note one important difference between their constitution and that of the ancient universities. They are not Republics; the Senate, the general body of professors and independent lecturers, is not the governing body. The court, with which control ultimately rests, is a large body representing all interests in the town and district. The court selects the council, which has executive power, and on both bodies the teachers have representatives; but in this way the effective management of the university is in the hands of a small body of business men ready to give the fullest attention to the wishes of the teachers, but capable of bringing other qualities to the consideration of the complex problems with which they have to deal, experienced in dealing with men and with affairs.

The prospects of the modern universities of England are bright; it is our business in our technical schools to supplement by all means in our power the efforts they are making to solve a difficult problem. Those who are to speak to-morrow can tell you better than I how the task is being done.

But with all the progress we have made we are still far behind Germany in very many vital respects. I am aware that the standard of entrance at our universities is being gradually raised; it will be long indeed before it reaches the nine years' secondary-school course required in Prussia for admission to any of its four technical universities. Still, we may look forward with some certainty to the time when our universities will do the work for England that those four universities do for Prussia; and while in some cases the connection between the technical college and the university will be very close, it is well to realise that there is an immense task before us which cannot be touched by the universities. University work is, in the main, day work; it calls for the whole time, the whole energy of the student; it may be that for a time, in some of its preliminary stages, some progress can be made by evening work, but a full university course demands more time than a hard-worked man should give after his day's task is done. The marked feature of the technical college is its evening work, the education it provides for those who have by day to make their living, raising and improving the quality of their work by training their intelligences, by putting clearly before them the why and the wherefore of the processes in which they take part.

I am not sure whether statistics exist as to the number of these students, the classes they attend, and the work they do. I have seen figures for London, and no doubt they might be obtained for the country at large. Few among these students hope to reach university standard, nor should their teaching be planned as though this were the main object in view. They fall, it seems to me, into two main categories, the adolescents—to use the word of the continuation schools report—who have recently left school to commence some trade, and for whom the continuation schools are designed, and then the older workmen, who want to understand the work they do, to prepare themselves for posts as foremen or overseers, and to be given some wider outlook on life than the shop or factory affords. There is room for a large development of both these tasks, for more coordination of the work, and greater continuity of effort. Elementary technical education is needed in all our towns, technical universities are needed in a few great cities only; for these latter we must concentrate both students and teachers.

A scheme whereby the evening technical institutions of a district would look to a technical university in one of the main centres of population as their university, would organise their work in connection with the day classes of the university, and would confine their own ambitions within moderate bounds, endeavouring to do their work within those bounds with the highest possible efficiency, would do much for the real interests of the nation. To promote such a scheme ought not to be a task beyond the powers of this association. It is a national work, and one which should readily gain the assistance of the national authorities.

In any scheme two matters must be borne in mind. A system of bursaries and scholarships must open the university to any student who can sufficiently profit by the opportunity thus offered; this is generally admitted; but in addition, it should be possible for the teachers to advance knowledge by research and study. To do this in each technical school or trade school is clearly impossible. If its importance were once recognised, it ought to be possible to arrange for facilities for the work for teachers in the district in the laboratories and class-rooms of the university.

Oxford and Cambridge are outside any such scheme. London, again, offers special problems of its own.

The two ancient universities need not detain us long. England owes so much to them, and English science so much to Cambridge in particular, the home of Newton, Young, Cayley, Stokes, Kelvin, and Maxwell, to name mathematicians alone, that one who realises all the benefits Cambridge can bestow upon her sons can only express the very deepest regret that the regulations of the University still close her doors to many young Englishmen on whose future she could exert an inestimable influence for good; still, even if an elementary knowledge of Greek were no longer necessary for entrance, Cambridge must devote herself rather to the study of pure science than to that of technics and engineering; students who go to Cambridge are prepared to spend time and money in gaining other advantages besides those of their technical education. Cambridge does not aim at being one of the great technical universities, but rather a home of sound learning and religious education from whence may spring great generalisations and new ideas to fertilise the world.

As to London, the problem is most complex. We have the university, the university colleges, now happily a part of the university itself, the Imperial Technical College with its own constituent parts, the Royal College of Science, the Royal School of Mines and the City and Guilds College, the Finsbury Technical College, and the various polytechnics and trade schools. What, from our point of view, are to be their connections, and under what scheme can they best combine to meet the wants of the seven millions of people for whom they provide?

We have to provide for the masters and leaders of industry by institutions giving a wide and comprehensive training suited to their needs; we have to secure that the workers shall be able to gain the knowledge needed to make their labour fruitful to themselves and to the State when young in technical schools adapted to the requirements of their trade, and when more mature in more highly specialised institutions organised to promote the scientific and practical study of special industries.

There is yet another class, limited in numbers, but valuable beyond measure to the State, those to whom it is given to advance learning—the potential Faradays of this great city.

For the first class we have the university, with its constituent colleges and parts; but are we to have one university or two? Shall London University embrace, as its name would imply, the whole of learning, the arts and sciences, literature, economics, theology, law, medicine, and the technical applications of science, or are we, like Berlin, to have two universities side by side, the one dealing with the older studies and pure science, the other the technical university, taking under its care those practical developments of science on which the welfare, nay, the very life, of the country hangs?

The matter is now under consideration, and this is, perhaps, hardly the place to discuss it. I would only say that the example set by Germany, though to follow it would entail many difficulties, is not lightly to be set aside. In any case, some change must come in the present government of the university—a change, I trust, which will place the executive control of its fortunes in the hands of a much smaller body than the Senate, will leave the various faculties more free to develop on the lines best suited to each case, and will concentrate more completely than is at present possible the highest studies,

affording to its students the opportunities which they now lack for post-graduate study and original research.

At any rate, we may take it that the Imperial Technical College will become the technical university for London—whether as a part of London University or as a new university working alongside it does not for our present purpose matter—concerned chiefly with honours students entering with high qualifications for a three or four years' course, including post-graduate study and research.

While referring to research, let me say I do not think you can successfully command a college, either by Act of Parliament or by Royal Charter, to become the home of original research. You can foster the endeavour by your regulations and the proper provision of funds, but success depends mainly on the men who guide the students and direct their energies. It was Liebig who made Giessen; the physical laboratory of Berlin became famous because Helmholtz worked there; it was not the cellar in the old university buildings, or the funds available for inquiry, which drew students from all over the world to Kelvin's laboratory at Glasgow. Rowland and his staff are the real founders of the Johns Hopkins University; to-day it is Thomson who fills the Cavendish Laboratory and Ramsay who attracts our ablest chemists to a somewhat second-rate laboratory in Gower Street. To expect a distinguished body of post-graduate students to flock at once to a newly opened college is a vain hope; but this is a digression. The Imperial Technical College will in time become the technical university of London. To achieve all that is aimed at, time and a more generous support on the part of those who have interests of education at heart alone are needed.

To this university there must be many avenues of approach; it must spread its roots afield; among its students some—by no means all—will pass through the polytechnics, for it appears to me the primary work of the polytechnics is not to prepare undergraduates for degrees in science and engineering, but rather, in the first instance, to supply needful knowledge to the worker.

No doubt it is necessary that, in view of the size of London, there should be centres of university work in various parts; it is desirable that some of the polytechnics should organise themselves so as to meet this demand; but is it necessary for all to do so? I do not wish to express an opinion so much as to raise a question.

I think I realise in part the feelings of the teachers; their university students are, I take it, among their best; the chance of doing research work turns largely on having one or two such students, and research work must be done if your teaching is to be kept alive and your courses, at any rate to advanced students, made fruitful; but is the highest work, or even work up to degree standard in many subjects, to be attempted in every polytechnic? The expense of such a plan must be very heavy, the strain on the teachers enormous. Suppose that, instead of endeavouring to cover all the instruction required for the B.Sc. degree, each institution made a serious effort to specialise only in one or two of the required subjects, leaving the others to other polytechnics, would not this relieve the pressure? In this chosen subject the principal would draw round him a large and able staff who would attract students from a wide area, and his college might in time become a specialised school of technical research. The teachers in this subject would find in their work ample opportunities for investigations of real importance; in the other branches of science the work would be avowedly more elementary, and the teachers probably less competent to research; but if the classes were mainly evening, such of the staff as wished might carry on investigation in the central laboratories of the university, or possibly at some other polytechnic where the subject of the research was made a special object of study.

One point more. Among your many students are some of very marked ability, perhaps of genius. Ease their paths by all methods within your power. Let me urge on the governors of your various institutions, and on those who hold the purse, if there are any such who can hear me, that expenditure on scholarships or bursaries for such, on material and apparatus for their researches, will soon repay itself in the effect their work will have in applying science to industry and trade, in discovering new means whereby the forces of nature may be harnessed to do the work required by man.

To conclude; my dream would picture a central technical university for London, a place where students only of proved capacity were admitted, where the staff were free to conduct original investigations and through these to teach their students, where scholars and prizemen from the various technical institutions of the district were collected, and where the teachers in the polytechnics and other colleges were freely welcomed to carry out researches.

In close connection with this there would be a number of colleges, day colleges chiefly, organised so as to provide the teaching required for the less advanced stages of the university. The suitable centres for this work would, of course, need to be selected with due regard to geographical conditions. Beyond these, again, would come the polytechnics, engaged chiefly in evening classes for the worker, but each with its one or more departments organised so as to provide teaching and means for research of the highest character, with its teachers recognised by the university, having a common interest in promoting the welfare of the central body and looking to the professors as their leaders in the search for truth.

Whether this dream comes true or not, I am clear that a scheme for technical education in London must aim at coordinating existing effort round a central institution, and in this endeavour must recognise the self-sacrificing labours of those who, in the past ten years, have done so much to forward the great movement—the governors and the staff of the institutions represented on this association.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The general board of studies will shortly proceed to the appointment of a Stokes lecturer in mathematics, in succession to Prof. Hobson. The appointment will be from June 24, 1910, to September 29, 1913. The annual stipend is 200*l.* Candidates are requested to send their applications, with a statement as to the branches of mathematics on which they are prepared to lecture, and with testimonials if they think fit, to the Vice-Chancellor on or before April 25.

The Allen scholarship has been awarded to Mr. R. Whiddington, of St. John's College. Mr. Whiddington took a first class in physics in part ii. of the natural sciences tripos in 1908.

SIR ALFRED KEOGH, K.C.B., formerly Director-General of the Army Medical Service, has accepted the rectorship of the Imperial College of Science and Technology, and will take up his work at an early date.

A REUTER message from Bombay announces that Sir Carrimbhoy Ebrahim has given to the Bombay Government a sum of 30,000*l.* for the improvement of scientific training, the encouragement of research, and the provision of scholarships to science students of the Mussulman faith.

A MEETING of the London branch of the Mathematical Association will be held at the L.C.C. Training College, Southampton Row, W.C., on Saturday, March 19, at 2.30 p.m. Papers will be read on the teaching of graphs, by Dr. T. Percy Nunn and Mr. P. Abbott. A discussion will follow, which will be initiated by Mr. D. Mair. All who are interested in the work of the association are invited to attend.

THE Fresenius Chemical Laboratory, Wiesbaden, offers opportunities for the pursuit of study and research in chemical science in an attractive part of Germany. The directors of the institution are Prof. H. Fresenius, Prof. W. Fresenius, and Prof. E. Hintz, and there is a large staff of lecturers and assistants. The summer term will begin on April 25, and among the subjects of lectures announced are chemical technology, stöchiometry, microscopy and chemistry, and analysis of foods. Copies of the regulations and the syllabus of lectures may be obtained upon application to one of the directors of the laboratory.

THE Old Students' Association of the Royal College of Science, London, has commenced the publication of a *Record*, which is to be issued at irregular intervals as

occasion may demand, containing information in regard to the work of the association and other matters of interest to old students. The association has accomplished some useful work during the first year of its existence. A register containing particulars of 729 old students has been published, steps are being taken with a view to secure academic costume for associates of the college, and inquiries are being made with the intention of offering evidence before the Royal Commission on University Education in London. We notice that Sir Thomas Holland, K.C.I.E., F.R.S., is the president of the association for the current year.

MR. F. M. DENTON, of the Carnegie Technical Schools, Pittsburgh, has been appointed to the post of associate-head of the electrical engineering and applied physics department of the Northampton Polytechnic Institute, Clerkenwell, London, E.C., rendered vacant by the resignation of Dr. C. V. Drysdale. Mr. Denton received his technical training at the Central Technical College of the City and Guilds of London Institute, and for a time he occupied a position on the staff of the electrical engineering department of the college. He left to join the staff of the General Electric Company in various departments at Pittsfield, Mass., and at Schenectady. After occupying these positions for one year he was, two and a half years ago, appointed lecturer in electrical engineering at the new Carnegie Technical Schools at Pittsburgh, a position which he still occupies and is resigning to take up his London appointment.

THE Department of Agriculture and Technical Instruction in Ireland has distributed a circular (Form S 41) giving full particulars of its summer courses of instruction for teachers, to be held, for the most part, in Dublin during July and August next. In July, courses will be conducted by the Department in, among other subjects, experimental science, laboratory arts, and drawing and modelling for teachers in day secondary schools, and in day and evening science and art classes; in domestic economy and woodwork for teachers in day secondary schools; and in hygiene and sick nursing and in housewifery for domestic economy instructresses. For August, four courses have been arranged, as follows:—in metalwork, practical mathematics and mechanics, and in handrailing, for teachers of wood-working; in industrial chemistry for teachers of chemistry in technical schools; in rural economy for teachers of experimental science in technical schools and teachers in national schools; and in school gardening for teachers in schools with gardens. The syllabuses of work contained in the circular show that great pains have been taken to provide practical courses dealing with subjects which will be directly useful to teachers in their work, and they should also serve the purpose of adding new life to their lessons when the teachers return to their schools.

ON Friday, March 11, Sir William H. White, K.C.B., F.R.S., distributed the certificates and prizes at the South-western Polytechnic Institute, Chelsea. Mr. W. Hayes Fisher, M.P., occupied the chair. After the principal had read the report for the session 1908–9, and the certificates had been distributed, Sir William said that in education he has three articles of faith, namely:—(1) every child should have an opportunity for education; (2) all who give proof of capacity of profiting by higher training must be allowed to go on; (3) in getting the best educational results the natural process of gradual selection must be adopted and allowed to operate. This leads to apparent wastage; but there is no real wastage. It is necessary to have educated men of all grades in all works, and this has specially to be brought home to the English manufacturer, who does not yet realise the importance of higher education. Sir William said that in Chelsea he felt at home, for when he came from Devonshire, before he joined the Admiralty in 1867, he studied at the School of Practical Shipbuilding at South Kensington, and lodged on King's Parade, Chelsea, almost within a stone's throw of the polytechnic. He was very pleased with his inspection of the polytechnic last week, and specially congratulated the governors on the large amount of their day work. From his experience of the technical colleges and institutes in London he had come to the conclusion that the polytechnics must be encouraged to carry on and extend day courses—their work in the evening was without parallel in the educational world. Various subjects must not be concentrated in special buildings, but each institute should make its courses as wide and as general as possible. London was so extensive, and its population was so large, that there was an ample field.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 10.—Sir Archibald Geikie, K.C.B., president, in the chair.—C. Gordon **Douglas** and Dr. J. S. **Haldane**: The causes of the absorption of oxygen by the lungs (preliminary). A short preliminary account is given of experiments affording clear evidence of a secretory activity of the lungs in the absorption of oxygen.—V. H. **Veley** and A. D. **Waller**: The action of nicotine and other pyridine bases upon muscle, and on the antagonism of nicotine by curarine. Nicotine (mol. wt. = 162) as such, or in the form of salt as nicotine tartrate, produces a very characteristic effect upon the contraction of isolated muscle. Its toxic power upon muscle, as compared with that of other substances that the authors have dealt with, is of the following order, *i.e.* approximately one-third that of quinine and considerably greater than that of curarine:—

Aconitine	10,000
Quinine	100
Nicotine	33
Strychnine	12
Curarine	5

The effect on muscle, characteristic of nicotine, is not produced by its parent base pyridine, nor by picoline, nor by piperidine. The order of toxicity upon muscle of these substances as compared with that of nicotine is as follows:—

Nicotine	100
Piperidine	50
Pyridine	10
Picoline	10

As has been indicated by Langley, there is an antagonism between nicotine and curare. Using a solution of pure curarine iodide prepared by Prof. Boehm, we find that the characteristic effect of nicotine upon muscle is abolished when the proportion of curarine to nicotine, reckoned by molecules, is 2 to 1, 30 to 1, and 160 to 1. With this last proportion a trace of nicotine effect can still be detected. In the case of other poisons, viz. strychnine, quinine, and aconitine, of which the effect *per se* upon muscle considerably exceeds that of curarine, there is, in a sense, an antagonism, as shown by abolition of the characteristic nicotine effect, but the abolition requires a greater mass of these more powerful poisons than is sufficient in the case of the less powerful poison—curarine. Thus, approximately, whereas 1 mol. of curarine can overpower upwards of 100 mols. of nicotine, it requires 1 mol. of strychnine or of quinine to overpower 1 mol. of nicotine, and 1 mol. of aconitine can overpower at most 10 mols. of nicotine. But in these cases the result appears to the authors to be intelligible as an effect of subdivision of muscle stuff between two poisons similar to the case of the subdivision of an acid between two bases; but this explanation is hardly applicable to the case of the antagonism of the strong poison nicotine by the weak poison curarine.—Prof. H. E. **Armstrong** and E. H. **Horton**: Studies on enzyme action, xiii., enzymes of the emulsin type.—Miss M. P. **FitzGerald**: Preliminary note on the origin of the hydrochloric acid in the gastric tubules.—C. J. T. **Sewell**: The extinction of sound in a viscous atmosphere by small obstacles of cylindrical and spherical form. The results obtained in this paper are only valid when the dimensions of the obstacles are small compared with the wave-length of the incident sound. For cylinders and spheres the radius of which is not less than 10^{-3} cm. it is found that the ratio of the lost energy to that incident upon the obstacle is at most of order 10^{-2}; this is a very much larger proportion than is obtained in the case of a non-viscous air. The results obtained for a single obstacle are extended without difficulty to the case of a large number

of obstacles. This extension is valid only when the space occupied by the obstacles is small compared with the total volume. It appears in the case of spherical obstacles that, if each small obstacle has radius 10^{-3} cm., and there are 10^{6} of them per cubic centimetre, then sound of wave-length 50 cm. will have its intensity diminished in the ratio of $1/e$ after passing through a thickness of less than 12 cm. of such a medium.—Dr. R. D. **Kleeman**: The ionisation of various gases by the β rays of actinium. A set of experiments carried out on the ionisation in various gases by the β rays of actinium. The results are of interest in comparison with the ionisations produced by the β rays of uranium, on account of the different penetrating powers of the rays. The results are exhibited in the subjoined tables. It will be seen that the relative ionisations by the β rays of actinium are practically the same as those obtained with the β rays of uranium.

Scattering of β Rays.

Absorbing substance	β Rays of actinium (Godlewski)	β Rays of uranium (Rutherford)
Aluminium	32·7	14
Mica	33	17·2
Brass	108	—
Copper	139	60
Tinfoil	154	—
Lead	163	122

Relative Ionisations.

Vapour	β Rays of actinium	β Rays of uranium
Air	1·00	1·00
H_2	0·159	0·165
$C_4H_{10}O$	4·28	4·39
C_2H_5Cl	3·33	3·24
C_2H_5Br	4·43	4·41
CH_3F	5·34	5·11

Geological Society, February 18.—Annual general meeting.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Prof. W. J. **Sollas**: Anniversary address: the evolution of man in the light of recent investigations. Considering first the human remains of the Pleistocene epoch, the president pointed out that, so far as the evidence extends, it shows that the cranial capacity of the human skull increases rather than decreases as we pass backwards in time. The oldest known human skulls are later than the Chalky Boulder-clay. The cranial capacity is merely a morphological character of unknown significance. Observation shows that no discoverable connection exists between it and the intellectual power. The most recent researches in comparative anatomy emphasise the close connection between man and the anthropoid apes, especially the gorilla and the chimpanzee. A similar result is afforded by the investigations of Uhlenhuth and Nuttall into blood-relationship. All recent researches converge to show that the genealogy of man is to be traced through the anthropoid apes and the catarrhine monkeys to the lemurs. Cope's suggestion of a direct descent from extinct lemurs receives no confirmation. Primitive characters, when present in man, can be better explained by regression and adaptation. Man probably diverged from the phylum of the primates above the point of origin of the gibbon, and not far from that of the gorilla and the chimpanzee. He owed his progress, in the first place, to emancipation from a forest life, and commenced his career as the ape of the plains. The erect attitude and the use of the hand as a universal instrument followed as a consequence. Ancestral man was probably a social animal at a very early period, and social life afforded a stimulus to the development of the powers of speech. He was probably distinguished by great bodily strength and by the possession of formidable natural weapons of defence and offence. With the invention of weapons made by art the necessity for natural weapons disappeared, and a regressive development of the teeth with adaptation to purely alimentary functions commenced. A purely human dentition characterises the Heidelberg jaw, which is the oldest known. This, however, still reveals in all other respects strong simian affinities. The growth of the brain in size and complexity might be correlated with the evolution and use of the hand, but to a far greater extent with the development of the powers of speech and the consequent exchange, multiplication, and coordination of ideas.

February 23.—Prof. W. W. Watts, F.R.S., president, in the chair.—T. O. **Bosworth**: Metamorphism around the Ross of Mull granite. The Ross of Mull granite is a coarsely crystalline plutonic mass, forming the western portion of the Ross of Mull, and extending over some twenty square miles. The intrusion is conspicuously later than the Moine rocks, and is regarded as one of the "newer granites." The rock shows very little evidence of faulting or movement of any kind, and is traversed by sheets of mica-trap. The eastern boundary of the granite is a very intricate line of junction with typical Moine schists and gneisses, into which it has been intruded. Injection-breccias occur along the margin, where the granite is crowded with schist-inclusions. The changes in the pelitic schists are of two kinds, and are considered under the separate headings (*a*) impregnation, and (*b*) thermal metamorphism.

Zoological Society, March 1.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—Sir G. F. **Hampson**: A list of the moths collected by Mr. Sheffield A. Neave in Rhodesia north of the Zambezi and the adjacent Katanga district of the Congo Free State. Nearly two hundred new species are described. The moth fauna of the district is mainly of a West African type, with a considerable admixture of East African and Mashonaland forms. As there are no high ranges of mountains or deep river valleys, the fauna presents a very uniform tropical African character, with no high mountain forms or forms peculiar to the faunas of the drier parts of southern or northern Africa.—T. H. **Burlend**: The urogenital organs of *Chimaera monstrosa*. This paper dealt with the urogenital organs of Chimæra, both immature and adult of each sex. Much of the early work of Leydig and Hyrtl, which later writers had ignored or disputed, was now confirmed and supplemented.

Royal Anthropological Institute, March 8.—Sir Herbert Risley, president, in the chair.—Dr. A. **Keith**: The Gibraltar skull. This skull was presented to the Museum of the Royal College of Surgeons, England, some forty years ago by Mr. Edward Busk. Huxley had seen the cranium, but evidently did not recognise that it was of the same type as the Neanderthal skull. The merit of discovering that this skull was Neanderthaloid and belonged to that ancient Palæolithic race of men to which Schwalbe has given the specific name of *Homo primigenius* belongs to several anthropologists, but to Prof. Sollas must be ascribed the merit of having given, quite recently in the Philosophical Transactions, the first detailed description. The skull deserved further investigation, because it was the only specimen of Neanderthaloid man yet known that showed the face in a perfect condition. In the two recently discovered examples described by M. Marcellin Boule and by Prof. Klaatsch, the facial parts were so mutilated that reconstruction was necessary to obtain an approximate conception of the original or natural form. Dr. Keith, with the aid of Mr. F. O. Barlow, had been able to obtain a cast of the interior of the skull, and was thus able to study certain surface markings of the brain. The brain-cast was remarkable for its width and for its flatness; the left occipital pole predominated over the right occipital pole, a character that has been associated with right-handedness. The fissure of Sylvius was wide and apparently open, but this character is due, as in native Australian brains, to the great size of the ridge of bone which occupies the fissure. It has been found possible to expose the sutures of the Gibraltar skull, and thus to localise definitely important points in its topography. The cerebral development of Palæolithic man has been very much underestimated. This is partly due to the fact that the height of the skull was measured from the inion to the glabella, two points which are fairly stationary in modern men, but which in Palæolithic men, as in anthropoids, grew upwards so as to occupy a relatively high position as regards the brain. These points are from 8 to 10 mm. higher in Palæolithic men; hence the height of the skull, when measured from them, is comparatively low. M. Boule has found the capacity of the La Chapelle skull to be considerably above the average for modern Europeans, and such was undoubtedly the case as regards

the Neanderthal and Spy crania. In the Gibraltar skull the capacity was low, below 1100 c.c., a small amount, partly owing to the skull probably being that of a woman and also to the fact that it was pre-Neanderthaloid in type. Indeed, when rightly analysed, the Gibraltar individual, as regards the type of cranium and size of brain, is intermediate between Pithecanthropus and Palæolithic skulls, such as those of the La Chapelle man or the skull known as Spy ii. The mastoid of the Gibraltar skull is simian in type; the groove for the attachment of the digastric muscle is exposed laterally, as in the anthropoids, in place of being covered by the mastoid processes. Palæolithic men were distinguished by the width of the attachment of the skull to the neck, as well as by the simian supraorbital ridges. The nose of the Gibraltar individual is unlike anything yet seen in a human being. Although in certain features it shows approximation to the gorilla, it is best described as the precursor of the prominent European nose. The jaw is remarkable for its width; in length it does not much exceed that of a modern European. The third molar is larger than the second, at least one so infers from the parts that still remain. This shows a very robust dental development. It is evident that Palæolithic man had reached quite a modern degree of brain development. If the Gibraltar individual be assigned to a Palæolithic date, for we can assign its period only from its conformation, there being no accessory data, then it must be assigned to a woman of a much lower brain development than the men now assigned to that period; but it is also possible that it belonged to a much earlier date than the Neanderthal-Spy men—to a race we know nothing of as yet. Dr. Keith also pointed out that in the pathological condition, known as acromegaly, the eyebrow ridges and attachment of the skull to the neck became enormously increased, thus reproducing a character which was normal in Palæolithic men. It seemed very probable that racial characters were determined by secretions of the more obscure glandular organs of the body, especially the sexual glands.

Mathematical Society, March 10.—Sir W. D. Niven, president, in the chair.—J. W. **Nicholson**: The scattering of light by a large conducting sphere.—Miss H. P. **Hudson**: The 3-3 birational space transformation.—W. F. **Sheppard**: The expression of the sum of the rth powers of the first n natural numbers and other similar functions of n in terms of $n+\frac{1}{2}$, and forms for the remainder in the Euler-Maclaurin sum-formula.

Linnean Society, March 3.—Mr. H. W. Monckton, treasurer and vice-president, in the chair.—W. **Bickerton**: Our British nesting terns.

PARIS.

Academy of Sciences, February 28.—M. Émile Picard in the chair.—Émile **Picard**: A general theorem of certain integral equations of the third species.—J. **Boussinesq**: The manner in which the potential of the velocities depends upon the initial state in the problem of waves by emersion.—A. **Haller** and A. **Brochet**: The oxidation of methyl ricinoleate by ozone. The ester fixes four atoms of oxygen on treatment with ozonised oxygen. The separation of the products formed by the interaction of this substance with sodium carbonate is described in detail; the position of the double linkage thus determined is in agreement with the constitution usually ascribed to this acid.—M. **Lannelongue**: A supplementary function of the foot in the yellow race. The foot in these races is not exclusively used for the support of the body. It is used for other functions, and becomes a prehensile organ, as in grasping an oar.—Émile **Borel**: A general condition of integrability.—Émile **Cotton**: Asymptotic solutions of differential equations.—Serge **Bernstein**: The conditions necessary and sufficient for the possibility of the problem of Dirichlet.—Joseph **Marty**: An integral equation.—Léopold **Fejér**: A pair of conjugated Fourier's series.—J. B. **Fournier**: A method of evaluating the temperature of superheated vapour. Superheated steam differs from saturated steam in that adjacent portions may have very different temperatures, and this fact has not been sufficiently appreciated in many instances when fixing the position of the thermometer designed to give the temperature of the superheated vapour. The error may amount to as much as 75°. The whole of the bulb, or corresponding portion of an electrical instrument, must be entirely immersed in the direct current of vapour, and contact with the walls of the pipe must be avoided.—Ch. **Féry**: A symmetrical coil for galvanometers with movable frame.—G. **Gabet**: The results obtained in the radio-automatic torpedo by a new telecommutator. The principles upon which the apparatus is based were given in a previous communication. Practical tests in the Seine have been successfully carried out.—E. **Louise**: A new method of analysis by miscibility curves. Application to essence of turpentine. Aniline is a suitable solvent for this work, four curves obtained with this substance being illustrated.—E. **Baud**: Cryoscopy in concentrated solutions. The concentration is taken as the weight of the solute dissolved in a given volume (100 c.c.) of the solution, a non-polymerised solvent being used. Results are given for ethylene bromide, benzene, and nitro-benzene as solvents.—G. **Denigès**: The detection of traces of formaldehyde in presence of acetaldehyde by fuchsine bisulphite. In liquids acid with sulphuric acid the red colour restored to the decolorised fuchsine solution by the acetaldehyde is much less stable than that produced by formaldehyde. The latter tends to increase on standing, the former to fade away.—F. **Bodroux** and F. **Taboury**: Syntheses effected with benzyl cyanide. Nitriles in ethereal solution react readily with sodium amide, giving sodium derivatives of the type R.CH.Na.CN. The latter can be converted into compounds R.CHR′.CN by alkyl halides. Several examples of the application of the reaction are given.—J. **Bougoult**: α-Cyclogeranic acid. The acetate of trimethylcyclohexenol is obtained in good yield by heating α-cyclogeranic acid with an acetic acid solution of mercuric acetate.—Marcel **Delépine**: The constitution of the dimeric aldehyde of crotonaldehyde.—A. **Wahl** and C. **Silberzweig**: The methyl methoxybenzoylacetates. The methyl esters, differing from the ethyl esters, can be distilled undecomposed in a vacuum. These compounds were prepared by Claisen's method. Details of the preparation and properties of these compounds are given.—A. **Backe**: A new compound contained in food products. The reactions of this substance are sufficiently close to those of salicylic acid to give rise to the suspicion that the latter substance has been added. This body is formed by the action of heat on certain sugar and starches, and resembles the maltol of Kiliani and Barlen.—Louis **Matruchot**: A new group of pathogenic fungi causing sporotrichosis.—G. **André**: The development of a bulbous plant. Variations in the weight of the dry material.—Ed. **Urbain**, Cl. **Scal**, and A. **Feige**: The sterilisation of water by the ultra-violet rays. The source of light employed was an arc formed between carbons containing alumina. It is pointed out that it is useless to attempt to utilise wave-lengths below 1860 Ångström units, since a thin layer of quartz or water absorbs nearly all rays of lower wave-length.—Mlle. **Cernovodeanu** and Victor **Henri**: A comparison of the photochemical and abiotic action of the ultra-violet rays.—I. **Chaine**: The vertical position and the thigh muscles.—C. **Vaney** and A. **Conte**: Researches on the development of the egg of the silk-worm.—Paul **Hallez**: The summer and winter spawning of *Prostoma lumbricoideum*.—J. **Nageotte**: The microscopical study, during life, of the activity of the myeline in the course of the Wallerian degeneration of nerves.—M. **Favre** and Cl. **Regaud**: Certain filaments having probably the signification of mitochondria in the generating layer of the epidermis.—F. **Bordas**: The medico-legal study of the benzidine reaction in the determination of blood spots. If the reaction is negative, blood is certainly absent; it is shown, however, that a positive reaction is given by substances other than blood.—E. **Doumer** and G. **Lemoine**: Obstinate neuralgic pains observed in patients suffering from excessive arterial tension.—Jean **Brunhes**: The predominance of erosion on the right bank of a river in times of flood.—Alfred **Angot**: The secular variation of the magnetic elements in the region of Paris.

March 7.—M. Émile Picard in the chair.—Maurice **Hamy**: The organisation of stellar spectroscopy at the Observatory of Paris. Details are given of the new

spectrograph, specially designed for the determination of radial velocities. Special attention has been given to securing constancy of temperature, with such success that the variations during several months have amounted to two- or three-hundredths of a degree.—J. **Boussinesq**: The integration of the equations of waves of emersion by Maclaurin's formula, in series always convergent, for a deep, endless canal and for an indefinite basin.—A. **Haller** and Ed. **Bauer**: The alkylation of fatty ketones by the use of sodium amide. By successive treatments with sodium amide and methyl iodide, pinacoline was converted into $(CH_3)_3.C.CO.CH_2.CH_3$, and ultimately into

$$(CH_3)_3.C.CO.CH(CH_3)_2.$$

In benzene solution this was further acted upon by sodium amide and methyl iodide, the symmetrical hexamethylacetone $(CH_3)_3.C.CO.C(CH_3)_3$ being formed. Various derivatives of these ketones, together with the corresponding ethyl compounds, are described.—Richard Dedekind was elected a foreign associate.—H. **Andoyer**: New fundamental trigonometrical tables.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1909. Observations were possible on sixty-seven days, the results being summarised in three tables, showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Ch. **Gallissot**: The phenomenon of Purkinje. An experimental study of the luminosity of two points, red and blue. The brightness of these artificial stars could be altered by known amounts. It is concluded that Purkinje's phenomenon has no sensible influence from the sixth magnitude upwards.—Arnaud **Denjoy**: The measurement of *ensembles*.—M. **de Séguier**: The symmetrical group and the alternating group.—W. **Stekloff**: The development of an arbitrary function in series proceeding in accordance with certain fundamental functions.—Joseph **Marty**: Developments according to certain singular solutions.—Sigismond **Janiszewski**: Contribution to the geometry of general plane curves.—M. **Hadamard**: Liquid waves.—Marcel **Brillouin**: Questions of mathematical physics.—A. **Dufour**: Unsymmetrical triplets; an example of an asymmetry of position proportional to the square of the magnetic field. The chromium line 5247·56 forms a triplet in the magnetic field the axis of symmetry of which is displaced towards the violet. This asymmetry of position with respect to the initial line increases as the square of the field.—E. **Caudrelier**: The discharge of inductors: the capacity of the electrodes.—André **Kling**: A new method of estimating dextro-tartaric acid. The estimation is based on precipitation as calcium racemate.—Léo **Vignon**: The diffusive power of certain artificial colouring matters. A study of diffusion shows that dye-stuffs considered as soluble in water fall into two clearly differentiated groups; those of the first group, of which picric acid is the type, form true solutions; those of the second group are only apparently soluble, and are incapable of diffusion, such as Congo red.—Pierre **Dupuis**: The action of phosphorus trichloride upon guaiacol.—Aug. **Chevalier**: The forest resources of the Ivory Coast. Results of the scientific expedition in western Africa. The products include kola and coffee, both in the wild state, a gum analogous to gum arabic, and several gum-resins.—Auguste **Joxe**: The modes of opening of achenes and kernels at the time of germination.—Ed. **Griffon**: Variation in grafting and asexual hybridation.—Gabriel **Vallet**: The penetration and bactericidal action of the ultra-violet rays with respect to the chemical constitution of the media.—H. **Bordier** and R. **Horand**: The action of the ultra-violet rays on trypanosomes. *Trypanosoma lewisi* in the blood of a rat was killed by an exposure for fifteen seconds to the ultra-violet rays of a quartz mercury vapour lamp. These trypanosomes were absolutely unaffected by a prolonged exposure to the X-rays.—Mme. Marie **Phisalix**: The natural immunity of batrachians and snakes against the poisonous mucus of the former: the mechanism of this immunity.—A. **Briot**: Properties of the serum of sero-anaphylactised rabbits.—R. **Robinson**: The dimensions of the cæcum and typhlectasis.—J. **Thoulet**: A lithological submarine map of the coast of Languedoc.—B. **Galitzine**: The determination of the epicentre of an earthquake from the data of a single seismic station.

DIARY OF SOCIETIES.

THURSDAY, MARCH 17.

ROYAL SOCIETY, at 4.30.—*Bakerian Lecture*: The Pressure of Light against the Source: the Recoil from Light: Prof. J. H. Poynting, F.R.S., and Dr. Guy Barlow.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Further discussion*: (1) Short Circuiting of Large Electric Generators and the Resulting Forces on Armature Windings: (2) The Design of Turbo Field Magnets for A.C. Generators with Special Reference to Large Units at High Speeds: Miles Walker.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual Meeting.—*Followed by*: The Surface Condenser in Mining Power Plant: W. A. MacLeod.

LINNEAN SOCIETY, at 8.—The Life-history of *Chermes himalayensis*, Steb., on the Spruce, *Picea morinda*, and Silver Fir, *Abies Webbiana*: E. P. Stebbing.—A Contribution toward a Knowledge of the Neotropical Thysanoptera: R. S. Bagnall.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Compounding and Superheating in Horwich Locomotives: G. Hughes.

OPTICAL SOCIETY, at 8.—Some Measurements of Stereoscopic Power: D. P. Boatman and R. J. Lucking.—Optical Instruments for Naval Purposes: T. Y. Baker.

FRIDAY, MARCH 18.

ROYAL INSTITUTION, at 9.—The Dynamics of a Golf Ball: Sir J. J. Thomson: F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction of Warships: N. Maas.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Coal Tar Colour Industry of England; the Causes of its Progress and Retardation: Ignatius Singer.

SATURDAY, MARCH 19.

ROYAL INSTITUTION, at 3.—Electric Waves and the Electromagnetic Theory of Light: Sir J. J. Thomson, F.R.S.

MONDAY, MARCH 21.

VICTORIA INSTITUTE, at 4.30.—Light, Luminaries and Life: Rev. A. Irving.

INSTITUTE OF ACTUARIES, at 5.—(1) On the Valuation of the Payment on the Death of a Pensioner of the Excess of his Contributions, with or without Interest, over his Pension Payments; (2) On a Method of Scheduling Particulars for the Valuation, in certain cases, of Prospective Pensions based on Terminal Salaries: T. Tinner.

TUESDAY, MARCH 22.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Birmingham Sewage-disposal Works: J. D. Watson.—Salisbury Drainage: W. J. E. Binnie.

WEDNESDAY, MARCH 23.

GEOLOGICAL SOCIETY, at 8.

CONTENTS.

THURSDAY, MARCH 24, 1910.

MUSIC.

Music: its Laws and Evolution. By Prof. Jules Combarieu. International Scientific Series. Pp. viii+334. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1910.) Price 5*s*.

THIS important work could only have been written by a musician who was acquainted with the history of music, and also had a considerable knowledge of sciences connected with music, such as mathematics, physics in relation to acoustics, physiology, psychology, and æsthetics. Almost every page shows the versatility of Prof. Combarieu in dealing with the various aspects of the subject, while his power of lucid description is conspicuous. There is also the graceful beauty of style peculiar to a Frenchman, and it has lost little or nothing in translation. The fundamental thesis of the book is that music is the art of thinking in sounds. According to the author, we can never hope to have an adequate conception of music unless we realise that it is a kind of intellectual activity associated with emotional states, but without those concepts that are the material of ordinary intellectual action. The study of acoustics, the study of sensations of tone, as was so fully carried out by Helmholtz in his first work, "Tonempfindungen," the study even of scales and major modes, are only to be regarded as contributions to a fuller understanding of music, although not a few writers, in dealing with these aspects of the subject, have deluded themselves with the notion that in so doing they were explaining the true nature of music. All this may be readily granted; but in justice to the physiologist and psychologist, on whom Prof. Combarieu now and then comes down heavily, almost with scorn ill-concealed, it must be contended that the foundation of music does consist of sensations, varying in kind and quality. The composer thinks in sounds which are related to each other according to laws well known to the composer, and which he often transgresses, and the master musical mind has a kind of instinct that perceives more deeply the hidden meanings of the phenomena of the cosmos and the still more ill-defined region of human thought and feeling.

Prof. Combarieu develops these ideas in a remarkable order. Instead of beginning with what is comparatively simple, the nature of vibrations, the mathematical basis of scales, &c., and the functions of the ear and brain in relation to sensations of tone, and then working onwards to the compositions of such men as Bach, Handel, and Wagner, he proceeds in the reverse order. First, he analyses a melody, showing how much there is in it that cannot be expressed in words, such as sensations of mere pleasure, the expression of emotional states, and the arousing of sentiments, and even trains of thought and of reminiscence, in the mind, and he arrives at the conclusion that music is, as it were, the dynamics of emotional life. He traces the evolution of music, the simple melody, the canon originating in religious feeling, the discovery of counterpoint, the use of rhythm as connected with bodily muscular movements, and the early relation of music to magic. Next he examines the development of music as an expression of the gradually increasing complexity of social life, in this way accounting for the origin of octaves, fifths, thirds, and other intervals, and the development of the major and minor modes. Muscular work requiring cooperation among many individuals taught men rhythm and musical time, and, by slow degrees, the various modes of the Greeks, Lydians, Phrygians, &c., reflected the social life and habits of the Greeks. A confluence of these minor modes has resulted in the minor mode of the present day. In modern music there is a fresher and greater use of the minor mode and of chromatic intervals, and there is less satisfaction merely with consonance, a development quite in keeping with the anarchical state of thought and feeling characteristic of the present day. The development of the orchestra from primitive instruments is one of the most remarkable phenomena in the evolution of music, and modern composers now strive to write something appropriate for each instrument.

Prof. Combarieu makes some excellent observations on Darwin's well-known opinions on the sexual relations of music. It is in most instances the language of love, but a sexual theory will not account for all music. The chapter on the physiology of music is the least satisfactory in this valuable book. We do not think the author does justice to the work of Helmholtz, probably because he fails to grasp the theory of the cochlea and its difficulties. We cannot follow him in his notion that, in some way or other, the cochlea can, in a reflex way, adapt itself to different combinations of tones. Here he merges into metaphysical discussions that are beside the question. The last chapter or section on music and living beings is rather fanciful in describing analogies between well-known physiological phenomena and music. The illustrations he gives are analogies and nothing more.

Prof. Combarieu's book is very suggestive. He takes a noble view of music, an art which does not seem even yet to have reached its climax. Great as are the works of Bach, Handel, Verdi, and Wagner, each reflecting in a subtle way their individual genius, moulded by the circumstances in which they lived and the influences that conspired to make them great musicians, there may yet be in store for the human race even greater works, which, in their turn, will reflect the more complex conditions of civilisation, in even higher planes of non-conceptual thought, and in deeper knowledge and feeling. One may also suppose that in this further evolution the organs of music, the ear and the brain, will become more complicated. The evolutionary process has not ended.

JOHN G. M'KENDRICK.

HYGIENE OF THE NERVOUS SYSTEM.

Why Worry? By Dr. G. L. Walton. Pp. 275. (London: W. Heinemann, 1909.) Price 2*s*. 6*d*. net.

Self-Help for Nervous Women: Familiar Talks of Economy in Nervous Expenditure. By Dr. J. K. Mitchell. Pp. 202. (London: W. Heinemann, 1909.) Price 2*s*. 6*d*. net.

MUCH that a few generations ago it was usual to attribute to disorder of conduct is, by many, now placed in the category of functional nervous disturbance, and concomitantly it has been sought to relieve judicial and ecclesiastical officers of their duties and to devolve them upon the medical profession. In the two small books under review we find, expressed in popular language, that which amounts to a series of short sermons written by medical men, and for the most part addressed to those who are suffering from the effects of a lack of self-control. For one of our authors it is "not his aim to transform the busy man into a philosopher of the indolent and contemplative type," but to enable him to do his work effectively by eliminating undue solicitude. The other defends himself from the possible criticism that his advice is not new. We cannot suppose any such defence will be necessary. The advice proffered is that of Epictetus, Marcus Aurelius, and Seneca, but stops short, we may presume out of respect for the attitude of current science towards current religion, at the plane of these philosophers.

Dr. Mitchell points out how some of the conspicuous and peculiar virtues of women may become sources of trouble. Strong affections and sympathy are apt to lead to emotional excess, and such excess, whether spent in grief, love, hate, or ambition, is the most extravagant form of nervous expenditure, and may eventuate in bankruptcy. A very frequently predisposing cause of nervousness is the too ready yielding to emotional expression, along with the cultivation of an excessive manifestation of emotion in speech and manner. Many women account it an attraction to give way to tears for trifling pains, or to loud complaints expressed in exaggerated language about small annoyances, and it is pointed out to these that to endure the smaller inevitable woes with equanimity is to form a habit which shall be of immense service when the larger troubles arise.

Much useful advice is given upon those physical causes which tend to develop nervous manifestations, or to exaggerate them when they are already present. On one hand there is a large number of persons who attribute many trifling derangements of various organs to their "nerves," and, on the other hand, there are others who fail to recognise their disorders as being nervous in origin until severe mental symptoms arise, and each class will find the information which may be gathered from these books of great help. Due attention, neither too prolonged nor too scanty, to the hygiene of the nervous system will in the future doubtless go as far as prophylactic hygiene has already gone in connection with the other systems, and it must be recognised that the education of the child is in this connection of paramount importance. Something between Spartan severity and the opposite extreme, to which there seems to be a serious danger of our passing, is the educational goal to which we should press, to the development of that degree of self-control which shall avert the nervous weakness which issues in each petty emotion usurping entire control over the body.

For those who are "nervously" disposed we can ask for no better advice than that given in the small volumes before us, and we should certainly feel assured that those who would read the books and would endeavour to act upon the suggestions therein contained were well on the road to recovery. Unfortunately, there is an enormous residue of patients who will listen to no advice, though they pay a man to give it them, and yet another class which, while recognising the advice given to be sound, seems wholly incapable of the amount of self-help requisite to acting upon it.

MYCOLOGICAL WORKS.

(1) *Researches on Fungi.* By Prof. A. H. Reginald Buller. Pp. xi+287. (London: Longmans, Green and Co., 1909.) Price 12*s*. 6*d*. net.

(2) *Die Würzelpilze der Orchideen, ihre Kultur und ihr Leben in der Pflanze.* By Dr. Hans Burgeff. Pp. iv+220; 3 plates, and 38 figs. in text. (Jena: Gustav Fischer, 1909.) Price 6.50 marks.

(3) *Fungi and How to Know Them: an Introduction to Field Mycology.* By E. W. Swanton. Pp. xi+210. (London: Methuen and Co., 1909.) Price 6*s*. net.

(1) DR. BULLER'S investigations, undertaken with the object of throwing light upon the production, liberation, and dispersion of spores in the group of fungi known as the Hymenomycetes, breaks new ground, and, as usual in such instances, will undoubtedly form the starting point of future research on the part of many students. A brief sketch of the components of a typical hymenium or spore-bearing surface are first dealt with. It is pointed out that swollen gill-margins serve to separate the gills, otherwise the spores could not be shed. This may be true in those instances where thickened gill edges exist, but in at least seventy-five per cent. of known agarics the edge of the gills is not in the least thickened.

Under nuclear phenomena it is pointed out that the passage of the nucleus from the basidium through the very narrow sterigma into the spore affords striking evidence of protoplasmic plasticity. This point has been previously emphasised by Wager. The classification of the Agaricineæ according to spore colour is dubbed as a purely artificial arrangement, but no valid reason for this statement is forthcoming. The author does not appear to realise that what the systematist understands by black spores are spores thrown down in the mass; no spores are black, even under the microscope, but they may be opaque, and consequently appear to be black.

In a work devoted to research it is generally assumed that the author is conversant with what has been done previously on the same subject; this, however, does not hold good in the present instance; for

example, the occasional sterility of the gills, which consequently remain colourless in species normally producing coloured spores, has already been discussed in more than one text-book, and the conclusion arrived at is identical with that advanced by Dr. Buller. Cystidia are included in the category of hair formations. Probably the definitions as to the origin of hairs are various, but certainly true cystidia—not to be confounded with swollen marginal cells—originate from deep-seated cells.

Coming to the crucial point of research, the liberation of spores, it is at once obvious that the author attempts generalisations on too narrow a basis, as proved by the following quotation :—

"Excepting a few gelatinous species which require further investigation, it is a general rule that in Hymenomycetes the hymenium is situated on the under side of the fruit bodies."

He has ignored, or does not realise, the existence of many hundreds of species included in the Hymenomycetes where the hymenium is on the upper surface of the sporophore, and pointing upwards, as in Corticium, many species of Stereum, Hymenochæte, Poria, &c., yet such species are as numerous and cosmopolitan in distribution as the species with which he is acquainted.

In the Agaricineæ and the Polyporeæ it is considered that the position of the hymenium on the undersurface of the sporophore has been primarily decided as affording the greatest facility for spore dispersion. The spores are very adhesive when fresh, hence to secure successful liberation the gills or tubes must occupy a vertical position, which is secured by the rigidity of the sporophore. Gravity is the principal orienting stimulus acting on the sporophore. The spores on a basidium are discharged successively; each spore is shot out violently to a distance of about $\frac{1}{10}$ mm., and afterwards falls vertically downwards. The horizontal projection of the spores necessitates that gills should be placed at a certain distance apart. The process of spore liberation is treated in detail. Some very ingenious and interesting observations on the rate of fall of spores are furnished, which, subject to modification owing to their size, specific gravity, and process of desiccation, ranges from 0·3 to 6·0 mm. per second. The specific gravity of spores is determined approximately by using heavy fluids contained in a counting apparatus. In the genus Coprinus the gills are usually stated to deliquesce, or melt into a black, inky fluid, and it was generally assumed that the spores were contained in this fluid. According to Buller, however, the spores are shot off and fall as in other Agarics, commencing at the margins, and when a narrow zone of the gill is depleted of spores, the naked portion of the gill is consumed by a process of autodigestion. A most interesting account of the means by which the spores falling from a fruit-body may be seen by the use of a concentrated beam of light is given, but perhaps the most unexpected phenomenon explained is the fact that the sporophores of certain fungi retain their vitality for years in a dried condition, and, after the application of wet cotton-wool, quickly revive and begin to shed their spores, a process which continues for some days.

It is estimated that the giant puff-ball produces 7,000,000,000,000 spores, also that only one spore out of about 20,000,000,000 spores ever succeeds in producing a mushroom capable of reproduction. In addition to the many valuable new discoveries and new theories bearing on subjects previously investigated by other observers, the book abounds with suggestions and sidelights which cannot but prove of immense service to future workers.

Ten plates and numerous excellent figures in the text are of much value in following and grasping clearly the various points raised by the author.

(2) Notwithstanding the extensive researches of Frank, Bernard, and others bearing on the relationship between fungi and the roots of phanerogams, resulting in the structures known respectively as ectotropic and endotropic mycorhiza, much yet remains to be done before we are in a position to formulate the significance of such combinations. Dr. Burgeff has contributed considerably to our knowledge in this respect, and has added many new facts bearing on the nature and life-history of those fungi met with in the roots of orchids. Fifteen different kinds of fungi were isolated and carefully studied from pure cultures. The majority of these produced asexual reproductive bodies, mainly under the form of long chains of minute conidia of the oidium type. No higher form of fruit was observed, hence the systematic position of these root-fungi yet remains to be determined.

Wahrlich's view that certain of the fungi found in the roots of orchids belonged to the genus Nectria has not been corroborated by Burgeff. Sclerotia are sometimes produced. On account of the general resemblance of orchid fungi to those of Rhizoctonia, Bernard placed all the forms he isolated from orchids under the last-named genus. Burgeff, on the other hand, has created a new genus—Orcheomycetes—for the reception of his various forms, which are named specifically after the host from which they were isolated; thus the form isolated from *Ophrys apifera* becomes *Orcheomycetes apiferae*. The wisdom of creating new generic and specific names for admitted form-species is doubtful, more especially as the author states that such names have no systematic importance or significance. The group characters are based on the behaviour and mode of growth of the fungus, as a pure culture, on the substratum. The specific features turn on the nature of the hyphæ, form and size of conidia, some of which are comparatively large, and in some instances there are indications of the formation of pycnidia.

All the described forms are of endotropic origin, truly ectotropic mycorhiza occurring only very seldom in orchids.

The question of nutrition in cultures was investigated, and the important fact noted that no assimilation of free nitrogen took place. All the species are aërobic.

The concluding part of the work deals with the

infection of the seed, and the future development of the fungus until the host reaches maturity.

Numerous excellent figures illustrate the different kinds of fungi isolated, also the progress of the fungus from its first entrance into the seed.

(3) An introduction to field mycology was a desideratum, and, unfortunately, still remains to be written. The present work is practically an imperfect mycological *vade mecum,* attempting to deal with every phase of the subject, instead of being confined to an introduction to field mycology, as stated in the subtitle. The first chapter deals with the general structure and morphology, and has obviously been culled from preceding works of very different dates, as some of the information is up to date, some of historical interest only, and some inaccurate, as the statement that in the Ascomycetes the paraphyses are probably abortive asci. Immediately following this statement it is announced that the paraphyses are a continuation of the vegetative hyphæ, which is a fact, and consequently precludes the possibility of their being abortive asci. Interesting chapters on the dispersal of spores, parasitism, habitats, &c., follow. The remarks anent edible and poisonous species consist of platitudes, and leave the student in doubt. The Jew's ear is not an esteemed esculent in some countries, but *Hirneola polytrichi,* an allied species, is.

Coming to the essential portion of the book, it is at once apparent that the author is one of those who consider that the name of a fungus is a point of primary importance; in fact, there is but little indication that anything else is of any importance. In dealing with the systematic side of a subject, it is universally conceded that the student should be first introduced to the primary groups, and approach by degrees to entities or species. The reverse order, however, is followed in the work under consideration. Families and genera are simply dealt with briefly by a key system, which the beginner cannot possibly grasp, whereas the species are described in detail, the result being that if the species are recognised at all, it will be by a rule-of-thumb method, and his knowledge of affinities will remain at zero. Experience has shown that when a student commences the study of mycology by dealing first with individual species, his knowledge rarely extends beyond recognising a given fungus by name. It is doubtless the same in other branches of science.

The specific descriptions are very uneven, some being technical and beyond the grasp of the beginner; others are altogether inadequate, whereas in the Ascomycetes no mention is made of the asci or spores, the only features of real importance. The statement that *Bulgaria polymorpha,* an ascigerous fungus, is the conidial form of *Ulocolla foliacea* might be regarded as a slip if many other equally glaring mistakes did not suggest lack of knowledge of the subject undertaken. The illustrations are numerous, consisting of sixteen coloured and thirty-two black-and-white plates. Many of the figures are good, some are poor, and some are mere parodies of the object they are intended to represent.

ELEMENTARY CHEMISTRY.

(1) *Elementary Chemistry.* By Hollis Godfrey. Pp. xiv+456. (New York and London: Longmans, Green and Co., 1909.) Price 4*s.* 6*d.* net.

(2) *Systematic Qualitative Analysis.* By Dr. R. M. Caven. Pp. xii+240. (London: Blackie and Son, Ltd., 1909.) Price 3*s.* 6*d.* net.

(1) WE have carefully read a considerable part of Mr. Hollis Godfrey's book, and have reluctantly come to the conclusion that as an elementary text-book it is not a complete success. It is true that the book contains much useful information, which is well arranged, that it is well printed and luxuriously illustrated, and that its general appearance is attractive; but the explanations are slovenly, the similes are childish, the historial references betray a curious ignorance of the original memoirs, and many of the illustrations, excellent though they are as photographs, are peculiarly inept.

We have, for example, a picture of an apple to represent "acids in nature," two views of a rather nondescript landscape to illustrate "earth compounds," a female haymaker looking at her watch with a haycock in the background to explain atmospheric pressure, another party of haymakers looking at a tiny spot in one corner of the picture (a balloon presumably) to indicate the lightness of hydrogen, and so on.

A few extracts will illustrate the other points above mentioned. "Chemistry is a science which explains the every-day things of life" (p. 2). "There are seventy or eighty different atoms" (p. 9), meaning, of course, different kinds of atoms. As a kind of corollary to this the author states that "since masses are made by the union of molecules, there exist only between seventy and eighty perfectly simple substances, &c.," forgetting a previous paragraph in which he defines a hypothesis as a belief, and the more important fact that the elements would continue to exist independently of any atomic hypothesis.

The same kind of loose treatment is extended to volume and weight.

"If we have the same volume, the same size piece, so to speak, we can tell at once whether one substance is heavier or lighter than another. But unless we have the same volumes we can tell very little about it" (p. 23).

Again, on p. 40, it is stated,

"A hot-air balloon rises because the air within the balloon bag heated by the flame, expands, grows less in weight and so pulls the light envelope up."

We have still to learn that dough rises owing to the growth of the yeast cells (p. 281). The relation of oxygen to ozone is compared to a man who disguises himself and assumes another name when engaged in crime. The catalytic action of manganese dioxide on potassium chlorate is compared to a person working in the dark and then in daylight.

"The sun comes out and floods the room with cheerful radiance. The man's hands work faster—swifter and swifter grow his motions, &c."

The references to the history of chemistry may be illustrated by the following extracts. We are told (p. 28),

"The explanation of the loss or gain in weight on burning *tasked* the best efforts of the whole scientific world for a couple of hundred years,"

and this is followed by an account of Priestley's discovery of oxygen which even his greatest admirers would scarcely sanction. After stating that Priestley *burned* quicksilver in the air and obtained a red powder, he goes on:—

"The experiment so far was no different from what had been done before, without result, but Priestley, with that brilliant imagination which has so often characterised the great leaders of science, saw a new possibility. If mercury had changed to a red ash by burning, could not the substance which had so changed it be obtained from the red ash in its original form by heating?"

Cavendish's discovery, we are told further on, settled questions which had troubled men of science for two centuries. To the question, "What is water?" Cavendish gave the reply, "It is hydrogen oxide."

Sufficient has been said to illustrate the peculiar defects of the book, and it is not a little surprising that none among the ten ladies and gentlemen named in the preface to whom the MS. and proof were in turn submitted should have directed the author's attention to them.

(2) Although we are deluged with books on qualitative analysis, Dr. Caven's new volume may be regarded as by no means a superfluous addition to the number. He starts on the perfectly correct assumption that qualitative analysis, properly studied, may serve as a foundation for a sound knowledge of practical and theoretical inorganic chemistry, and develops his method along these lines. There is, of course, a great deal about group reagents and tables of separation which are common to most books on the subject, but there is, in addition, a useful general introduction, which is clear and concise, and a final chapter on the systematic examination of inorganic substances. The author does not tell us for what class of student the course is intended, and now that it is becoming the fashion to serve up chemistry to suit the diverse needs of different classes of students, or, as someone expressed it, to sell it in assorted penny packets, we doubt whether any but the embryo professional chemist could give the time necessary to complete it.

It is doubtful, too, if it is desirable for any student to postpone quantitative work until so much qualitative analysis has been assimilated.

Experience shows that an early acquaintance with the former is an excellent discipline in careful manipulation and exact observation, and the best antidote to untidy and sloppy habits of work. J. B. C.

OUR BOOK SHELF.

La Vita di Michele Faraday. Narrata da Andrea Naccari. Pp. 370. (Padova: Fratelli Drucker, 1908.) Price 3 lire.

THOUGH there exist four well-known biographies of Faraday in the English language, one only, the brief essay by Tyndall, "Faraday as a Discoverer," has been translated into Italian. Neither, until the appearance of the work now under review, had any Italian biography of Faraday been written. Prof. Naccari, whose position as professor of physics in the University of Turin guarantees his competence in physical science, and who is himself an experimental investigator of some distinction, has now written a life of Faraday which worthily presents the career of our great countryman. He has drawn freely and with due acknowledgment from all the four English biographies, and has had the advantage also of being in possession of the volume of printed correspondence between Faraday and Schönbein, which was published more recently than any of the four. Thus, without being either encumbered with the mass of details of Bence Jones's authoritative memoir, or restrained within the smaller compass of the three smaller biographies, he has been able to produce a work which in certain aspects is the most satisfactory life of Faraday yet compiled. He has not failed to incorporate the newer material while preserving what was of permanent value in the old.

The life-story follows the familiar lines. The author has not been able to add anything to our knowledge of the doings or wanderings of Faraday in Italy as the assistant of Davy in his eighteen months' tour of 1813–15. Neither has he thrown any further light upon the episode of the misunderstanding between Faraday and Nobili and Antinori in 1832 respecting their supposed correction of errors which he had not committed. In the author's preface he states that in his first ten chapters he has considered the man rather than the philosopher, with the intention to make him known and to make him loved. In his eleventh and last chapter, which occupies more than one-third of the book, he treats of Faraday's scientific work. Here he follows conscientiously and skilfully the evolution of Faraday's discoveries in their chronological order, but discusses them in their relation to modern views and discoveries. He lays great stress upon Faraday's electro-optic pioneering discoveries as having been provocative of so much of the later developments of physics. He concludes by citing a characteristic passage from the peroration of one of Faraday's last Royal Institution discourses in 1858.

The book is not illustrated by any cuts. It avoids all mathematical expressions; but it is eminently readable, and is well printed. English men of science owe a debt of gratitude to Prof. Naccari for his faithful presentation of one whose memory they so highly honour.

Botanisch-Mikroskopischer Praktikum für Anfänger, By Prof. Martin Mobius. Zweite Auflage. Pp. xi+123. (Berlin: Gebrüder Bornträger, 1909.) Price 3.20 marks.

THE exercises, sixty-four in number, contained in this little book are designed to make the student familiar with the outlines of plant structure in the chief subdivisions of the vegetable kingdom. The directions for making and mounting the preparations are clear and good, and the text is not overburdened with the details which the student ought to learn from the preparations themselves. The illustrations, which are diagrammatic, may also be found useful, although we think the work would not have been impaired in value had they been omitted. The fact that a second edition has been reached proves that its author has met a need felt for such a book, but it seems odd to discover the statement that the aleurone-containing cells of the castor-oil bean belong to the cotyledons (Keimblätter). We also prefer the style of *Ranunculus acris* instead of *R. acer* (p. 9, &c.). But on the whole the book is useful, well printed, and sensibly bound, and its price is moderate.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Fertilising Effect of Soil Sterilisation.

WITH further reference to the work of Messrs. Russell and Hutchinson on soil sterilisation (*Journal of Agricultural Science*, October, 1909), it may be interesting to record some information of which I have recently become possessed.

Some of the large growers of cucumbers, tomatoes, &c., under glass for the London market have for some little time adopted the plan of injecting jets of steam into their soil before planting, not with any view of increasing its fertility, but with the view of destroying slugs, insects, &c. In the experience of some growers the productivity of the soil after steaming has become so greatly increased that, if anything like the usual quantity of stable manure is mixed with the soil, the plants grow with such rank luxuriance as to spoil their bearing capacity, exhibiting all the symptoms that would be expected as the result of a heavy overdose of nitrogen.

This experience has been communicated to me by growers who were previously unaware of the Rothamsted work. At the moment they were feeling in somewhat of a dilemma: if they did not steam the soil they suffered from insect pests; if they did steam it they were obliged to curtail the supply of stable manure, at the expense of lowering the subsequent soil temperature, which is normally maintained at a high level by the fermentation of the manure. No doubt means may be found of adjusting the various conditions satisfactorily, but meantime the observation appears to afford striking independent confirmation on a practical scale of the indirect fertilising effect of partial sterilisation in killing off the phagocytes or protozoa which normally keep down the numbers of those bacteria the task of which is to turn organic nitrogen into plant food. BERNARD DYER.

17 Great Tower Street, London, E.C., March 15.

Certain Reactions of Albino Hair.

IN a note in the *Journal of Physiology* (vol. xxxviii.) on the chemical nature of albinism, Mr. Mudge describes some interesting observations which he made upon rats' skins. Starting with the presumption, based upon the work of Miss Durham and Cuénot, that an albino carries a chromogen and lacks the ferment necessary to produce pigment from it, and supposing that fermentation is a process of oxidation or reduction, Mr. Mudge argued that it might be possible to produce pigment artificially by means of an oxidising or reducing agent. He found by experiment that immersion of albino rat skins in a solution of 10 per cent. formalin and 70 per cent. alcohol in equal volumes resulted in a "vivid yellow colour" in the hairs; he further states that these coats, when washed in water and immersed in H_2O_2 (20 vols.), become changed in colour from vivid yellow to a "brownish tint" in about twenty-four hours. He adduces arguments to show that the coloration is due to the presence of a specific body in the hairs diffused through the keratin, and not to mere reaction between the keratin and the formalin.

I have repeated these experiments with various skins. In the case of the single albino rat skin which I used, the vivid yellow was obtained immediately on immersion in the formalin mixture. The change to brown in H_2O_2 was not obtained, but complete decoloration resulted from immersion in this reagent. Prolonged immersion in the formalin mixture also produced almost complete decoloration.

With guinea-pig albinos carrying, respectively, black, chocolate, and red, negative results were obtained, as they were also with a single mouse skin.

What struck me as particularly interesting in connection with the yellow colour produced by the formalin mixture in the coat of the albino rat is the fact that it is a peculiar canary-yellow, which I remember to have seen elsewhere among mammals only in members of the stoat family when the winter whitening is incomplete. A piece of pale yellow stoat fur acquired a much more intense yellow colour as a result of twenty-four hours' immersion in the formalin mixture; a similar piece was decolorised by H_2O_2. There can thus be little doubt that the yellow body produced artificially in the fur of the albino rat is a substance similar to the yellow pigment of the stoat's winter coat, and therefore probably represents a stage in the reduction of the pigment to the condition in which it exists in the white hairs.

Miss Durham tells me that it is a well-known fact that albino rats do not remain pure white if they are exposed to the action of light. Just as darkness is necessary for the production of a pure white coat in the rat, so a certain degree of cold seems necessary in the case of the stoat tribe, though in their case a change to a warmer climate does not at first prevent the usual colour-change in winter. Thus Eric Parker, in "The Book of the Zoo," points out, concerning a certain foreign pine-marten, that "the first winter he spent in the Garden his fur turned almost white to match the snows he would naturally have expected. The last two winters it remained brown, though it has lightened considerably towards yellow." This repetition of a periodic act without the usual stimulus recalls certain phenomena in plants, which Mr. F. Darwin attributes to memory. IGERNA B. J. SOLLAS.

Nitrogen-fixing Bacteria and Non-leguminous Plants.

MAY I be allowed to direct attention to two errors in Mr. Hall's letter in NATURE of December 23, 1909?

Mr. Hall states that "Pseudomonas and Azotobacter together (1·24) are less effective than when grown separately (0·91+0·56)." This comparison is incorrect. The fixation of free nitrogen by bacteria is estimated in terms of milligrams of nitrogen *per unit of carbohydrate* in the culture solution. Pseudomonas and Azotobacter together give 1·24 N for *one* unit of carbohydrate. Pseudomonas and Azotobacter grown separately give 1·47 N for *two* units of carbohydrate, hence the correct comparison is:—

	Per unit
Pseudomonas and Azotobacter together	$=1{\cdot}240$ N
Pseudomonas and Azotobacter separately	$=\frac{1{\cdot}47}{2}=0{\cdot}735$ N.

Hence my conclusion that Pseudomonas and Azotobacter together are *more* effective than when grown separately is, I think, justified.

The second error has reference to a mean experimental error of ± 10 per cent. Mr. Hall writes:—"By an error which the context rendered sufficiently obvious, I wrote 'oats' instead of barley when dealing with Prof. Bottomley's first-quoted experiment with soil." May I point out that oats were the only plants mentioned in the "first-quoted experiment with soil"? Even if the increase of barley (13·6 per cent.) be taken, one fails to see how it is "sufficiently obvious" that a mean error of ± 10 per cent. *more* than covers an increase (the lowest of the results quoted) of 13·6 per cent. W. B. BOTTOMLEY.

King's College, Strand, W.C., February 16.

A Sample of Spurious Correlation.

THOUGH regretfully unable to do justice to the mathematical reasoning of Dr. G. T. Walker in NATURE of January 6, I may, perhaps, be allowed to say that it is of the essence of the method that those dots (each expressing a comparison of two sums of thirty items) tend to arrangement in a straight band, or strip, with fairly defined borders. It is expected that future dots will generally come within those limits; but to affirm this in a given case, to say, *e.g.*, that the next dot will not be below a certain level, is it not, necessarily, to say something quite definite as to the character of the coming season, as that its rainfall, frost days, or other feature considered, will not be below a certain numerical value? If the one statement is warranted, so (by the nature of the case) is the other. Thus the essential point seems to me to be whether the past distribution of those dots affords a reasonable clue to their future distribution, and I do not see that my critic throws doubt on this.

I think (with all deference) that anyone who will give the method a full trial will find it distinctly helpful in a number of cases (I do not say in all).

ALEX. B. MACDOWALL.

8 Marine Crescent, Folkestone, January 14.

IN my former letter in NATURE of January 6 I attempted to prove that the arrangements of dots in a band would occur even if the numbers of which the sums were taken were entirely independent of one another, in which case a forecast regarding one of the numbers could not possibly be made from knowledge of the remainder. A forecast could only be made if it were shown that the width of the band were smaller than would be expected on the hypothesis of pure chance, and this vital point has received no consideration.

The situation may be made clearer by reference to the original letter in NATURE of September 16, 1909. The essence of the method is that, if we were forecasting for 1910, the dot the two rectangular coordinates of which are the sums of data for thirty years up to 1909 and 1910, respectively, will lie near to a line through the origin at an angle of 45° with the axes. Thus the sum of the data from 1880 to 1909 will be *nearly* equal to the sum of the data from 1881 to 1910, or the data for 1880 and 1910 will be *nearly* equal. If the *nearness* to equality has any value at all for forecasting, this is equivalent to asserting that the data in question tend to be repeated after thirty years, or have a thirty years' period; but as the same result could be reached if 25 or 35, or any other comparable number, had been substituted for 30, it will be seen that the reasoning cannot be free from error.

That the nearness to equality is inadequate is clear from the diagram in the original letter. The edges of the band there intercept a length representing about thirty-six days along any vertical ordinate. Hence all that can be inferred in forecasting for 1910 is that the number of hot days will probably not differ by more than ± 18 from the number of hot days in 1880; and as the average number of hot days in a year is stated as fifteen, it appears that a forecast so entirely vague could be made without any analysis whatever.

GILBERT T. WALKER.

Kodaikanal, February 21.

SOME SCIENTIFIC CENTRES.

No. XV.—THE MOUNT WILSON SOLAR OBSERVATORY OF THE CARNEGIE INSTITUTION OF WASHINGTON.

MOUNT WILSON rises 6000 feet, almost abruptly, from the plain in which lie the twin cities of Los Angeles and Pasadena. From the mountain top these cities appear at night as glittering star clusters; by day they are seen through a haze of dust which the ascent of the mountain has put below our feet. Beyond is the vast Pacific; above our heads the glorious sky of California; around us the buildings of perhaps the best equipped observatory in the world.

These words are written by anticipation. Prof. Hale has invited the International Union for Solar Research to hold its next meeting on Mount Wilson on August 29, 1910, and astronomers and physicists from all parts of the world are eagerly looking forward to the occasion. The present writer is not, however, altogether a stranger to the scene; he was on Mount Wilson in 1904; but at that time the observatory was in its infancy. It had not even been decided on what scale it was to be designed. Prof. Hale had realised the magnificent opportunities offered by the climate and site, and he had made urgent application to the Carnegie Institution for funds adequate to deal with the serious difficulties to be overcome; but he had also resolved that, if his application was not granted, there should still be a solar observatory on Mount Wilson, for which he would himself provide the funds, so that he had already commenced building operations. Nevertheless, the utmost provision which he and his courageous wife could afford to make would naturally fall far short of what was needed for a suitable observatory, and he was therefore anxiously awaiting the answer of the Carnegie Trustees. Fortunately for astronomy, it was favourable; and since it was received one marvel has followed another in rapid succession. The visitors will be drawn to Mount Wilson as to the main focus of astronomical enterprise and success at the present moment.

The first of the principal instruments to be completed was the great horizontal Snow telescope, originally constructed at the Yerkes Observatory, with the aid of funds given by Miss Snow, of Chicago. The concave mirror, of 24 inches aperture and 60 feet focus, is fed by a cœlostat with plane mirrors of 30 inches and 24 inches, the beam of light being sheltered by a house specially designed to guard against temperature effects. To this telescope can be attached a spectrograph of 18-feet focus, or a 5-foot spectroheliograph. The heavy parts of the apparatus are mounted on massive stone piers, built with great labour, since it was found that the stone in the neighbourhood was unsuitable, and that materials had to be brought up from a lower altitude by mules.

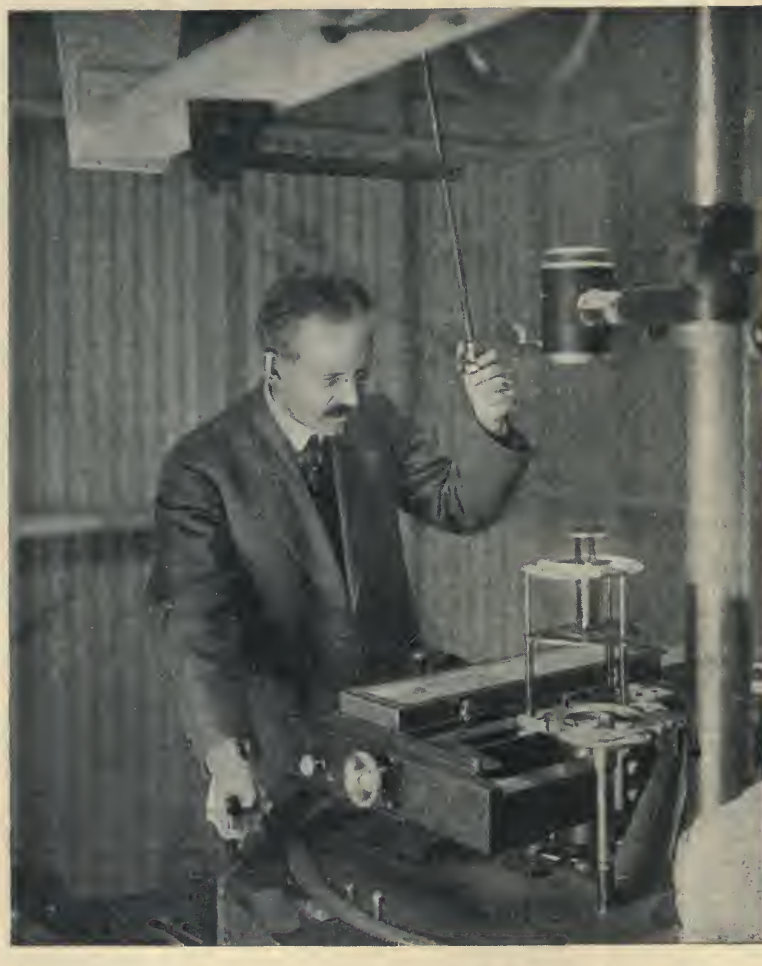
But, successful as this powerful instrument has been, it has also served to point the way to possible improvements. Experience of its working suggested that a *vertical* telescope might be in various ways better than a horizontal one; and accordingly a "tower" telescope was constructed, with the cœlostat mounted on a tower 60 feet high, built as a skeleton framework. This experiment was so successful that a more ambitious one was at once projected, and a tower 150 feet high is under construction. As wind pressure will be much more serious on this new structure, Prof. Hale has adopted the ingenious device of building an outer tower for protection, surrounding every bar of the inner tower by a tube of the outer. The lower parts of these tower telescopes are contained in wells sunk many feet into the ground.

Thirdly, there is the beautiful 5-foot reflector, made by Prof. G. W. Ritchey, who has already proved his skill in such work. The mirror was made at the Yerkes Observatory some years ago, but has had to wait until a mounting could be provided on Mount Wilson; and, indeed, there was a still earlier provision to be made; the track up the greater part of Mount Wilson was originally only 3 feet wide—a mere ledge in a precipitous descent—and up this narrow track the materials and instruments were carried, at first on mule back, later in a specially designed carriage, with steering fore and aft, and drawn by a mule. But the 5-foot mirror and its mounting could not be taken up in this way, and it was necessary to widen the track to 5 feet throughout its whole length. This was not accomplished without serious delays, owing to severe storms, which sometimes destroyed weeks of labour; but it was finally completed, the instrument was taken up and mounted, and at the meeting of the Royal Astronomical Society on December 10, 1909, were shown some photographs of Mars taken with this great telescope which far surpassed anything of the kind yet seen, and for which the president was requested to convey a special vote of thanks.

A still larger telescope, with a mirror 100 inches in diameter, is to be attempted on Mount Wilson, but is not yet within sight of completion. Round the existing three great instruments are grouped a number of other buildings; first and foremost a physical laboratory, so indispensable now in astrophysical work; also an astrophysical museum, and a variometer house; and then such necessary accompaniments as a power-house, a pump-house, storage-houses, and dwellings. The establishment is not adapted for ladies and children, and the chief residence is called the "Monastery." Distressing news reached us recently that the "Monastery" had been burnt down, owing to the carelessness of a temporary servant. Fortunately it contained no original photographs or records, and most of the books had been

taken down to Pasadena, but many were burnt. The building and contents were insured, but re-building cannot be commenced until after the close of the rainy season in the spring, so that the observers will be put to some inconvenience during the next few months, though there are now so many residences on the mountain that they can find temporary quarters.

In Pasadena, 6000 feet below, are the instrument shop, office, physical laboratory, &c. Here also dwell the wives and families of the observers. There is, of course, communication constantly by telephone and frequently by personal visit between the two departments of the observatory. Much practice has made the observers expert and rapid climbers.



Prof. G. E. Hale at the 30-foot spectrograph of the 60-foot tower telescope, arranged for photographing the spectrum of a sun-spot with rhomb and Nicol prism.

Our thoughts naturally turn from the contemplation of so magnificent an installation to the man who designed it, and has brought it to such perfection of efficiency in the short space of six years. It is, of course, not the first achievement of Prof. Hale. Just six years ago it fell to the lot of the present writer to review his work on the occasion of the award to him of the gold medal of the Royal Astronomical Society. That work already comprised the successful inception of the spectroheliograph and its use in depicting the "flocculi" at various "levels" in the solar atmosphere (the connotations of the terms in inverted commas having been suggested by the medallist only a few weeks before); also a considerable piece of work on the spectra of fourth-type stars; also the foundation and equipment, not only of the private observatory at Kenwood (Chicago), but of the great Yerkes Observatory, with its giant telescope and other magnificent resources for the study of astrophysics; also the establishment of the *Astrophysical Journal* as an indispensable aid to workers. Such a record might well have contented an ambitious man at the end of a long life, but it is not too much to say that Hale has in the intervening six years eclipsed these achievements, together and separately, by new ones. The workers who had been put in communication by his Journal have been drawn into closer companionship by the International Union for Solar Research, which he inaugurated at St. Louis in 1904, and which he has invited, after meetings at Oxford (1905) and Meudon (1907), to meet at Mount Wilson this year, as above stated. His record of work now includes the photographic mapping of the sun-spot spectrum (a long-standing problem solved) and the discovery of magnetic vortices in the sun—a truly sensational discovery, and one which is certain to lead to others; and his work in founding the Yerkes Observatory has been treated as preliminary to the real business of adapting the splendid Mount Wilson Observatory, point by point, to the pressing needs of solar physics.

We should lose a valuable lesson if we did not note the steady progression in enterprise which has built up the success. Prof. Hale has several times publicly insisted upon the value of work with modest apparatus, such as he began with himself. During a visit to England in 1907, he gave an address to the Royal Astronomical Society on "Some Opportunities for Astronomical Work with Inexpensive Apparatus" (Mon. Not. R.A.S., lxviii., p. 64), which not only emphasised the value of such work, but gave a number of concrete suggestions to intending workers. The difficulties of making a beginning are well known; but those who earnestly consult this lecture will find most of them removed. It is, of course, assumed that there is a desire to work; Hale addressed himself to "the amateur," defining him as "the man who works in astronomy because he cannot help it, because he would rather do such work than anything else in the world, and who therefore cares little for hampering traditions or for difficulties of any kind." These noble words are not only a stimulus; they also clearly reflect the character of the man who uttered them, and go far towards explaining his success. For the rest, we may accept his own estimate of the importance of beginning with small means, and of the value (several times emphasised in letters to the present writer) of the encouragement of his father. His father bought him a telescope (an excellent 4-inch Clark), but not until he had first made one himself; his father also bought him the spectroscope with which he first photographed a spectrum, to his huge delight, but this was not

until he had first worked with home-made apparatus; his father built the Kenwood Observatory, but not until his son had matured his plans by work at Harvard and elsewhere. "His policy always was," writes the son in one of his letters, "to induce me to construct my first apparatus, and then to give me a good instrument if my early experiments were successful." On the death of this wise and kind father, his children established, in pious and affectionate memory of him, the "William E. Hale Fund" for the encouragement of research, which has already aided, in an unobtrusive but none the less efficient manner, several scientific projects of different kinds. His lessons are so deeply impressed on the mind of his son that in the address above referred to he said, "with all seriousness, that it is a fair question whether large observatories, with powerful instrumental equipment, should be established, if they tend to keep back the man who is pursuing the subject with less expensive appliances, and is introducing, through his careful consideration of the possibilities of research, the new methods which in the process of time will take the place of the old ones."

A few facts and dates may be given here. George Ellery Hale was born in Chicago on June 29, 1868 (a few months before the classical observations of prominences without an eclipse, on which he was to build his main work), the son of William E. and Mary S. Hale; he married in 1890 Miss Evelina S. Conklin, of Brooklyn, N.Y., and has a daughter and a son. He entered the Massachusetts Institute of Technology (Boston) in 1886, taking the course in pure science, and graduating S.B. in 1890. He spent some time at the University of Berlin in 1893–4. While in Boston he was enabled, by the kindness of Prof. E. C. Pickering, to spend his spare time at the Harvard Observatory, doing any work assigned to him. The principle of the spectroheliograph occurred to him in the summer of 1899, but experiments were not then successful. He first photographed the prominences in the spring of 1891, within a week or two of similar successes by C. A. Young and Deslandres; but this achievement must be carefully distinguished[1] from the construction of the first successful spectroheliograph, in which Hale had a clear lead of all other workers. It was completed in January, 1892, and from that time regularly recorded, at the Kenwood Observatory, prominences and faculæ. Before the end of 1892 the project for the great Yerkes Observatory was already on foot, and was completed in the autumn of 1897. We may note in passing two incidents of that early history; first, that the project originated in a chance conversation with Alvan G. Clark at the Rochester meeting of the American Association for the Advancement of Science. Hale then learnt of the existence of two discs of glass available for a large telescope, and immediately began the search for a Mæcenas. Such incidental results of scientific gatherings are sometimes forgotten in estimating their value. Secondly, after several applications had failed, when ultimately the matter was laid before the late Mr. C. T. Yerkes, he replied at once, inviting President Harper and Mr. Hale to call upon him, and telegraphed for Mr. Clark as a result of the interview. His rapidity in decision seems to have been noteworthy, even in Chicago.

It would unduly extend this brief notice to follow the history of the Yerkes Observatory during the years from its completion in 1897 until Hale handed over the directorship in 1904 to Prof. E. B. Frost, in order to devote himself to the Mount Wilson Observatory. One is sometimes tempted to peer into the future; from Kenwood to Yerkes, from Yerkes to Mount Wilson, from Mount Wilson to ——? Does a fourth term of the series ever occur to Prof. Hale in his dreams? Series are treacherous to deal with; "it is most unpleasant," once remarked an eminent mathematician who has devoted part of his life to them, "to dream that you are expanded in an infinite series, and that it will not converge." There is a notable divergence in the series of observatories with which Prof. Hale might identify himself; but then it may not be infinite. Indeed, we expect to find —recurring to the attitude of anticipation with which this notice began—we confidently expect to find in August next excellent reasons why the series should stop short at its third term. It is difficult to imagine how conditions for work could be bettered. Mount Wilson has great instruments and a fine climate; it has the financial backing of the wealthy Carnegie Institution; it is within easy reach of Pasadena, and in telegraphic communication with the whole world; and last, but by no means least, it has already an able staff of workers, including men like Adams, Ellerman, and Ritchey, whose names are famous wherever there is an astronomer. Those who have visited the mountain are enthusiastic in praise of the conditions for work. A notable visit was paid by Prof. Barnard, who found the times of exposure required for his photographs considerably less than at the Yerkes Observatory.

The main purpose of the Mount Wilson Observatory is solar research, but a wide interpretation must be given to the term. Prof. Hale has often emphasised the representative character of the sun—it is the one star near enough to be examined in detail; but it is nevertheless a star, and to understand it we must study it alongside other stars; we cannot do justice to the sun by working at the sun alone. Hence he has insisted on an adequate equipment for stellar work at Mount Wilson. The method of attacking scientific problems along more than one line is a characteristic feature of Hale's work generally, and has been an important factor in his success. To give a recent and striking instance. Along one line he was developing the spectroheliograph to the point where good photographs could be obtained in red light (Hα), and this led to the discovery of the solar vortices; along another line, which might have seemed irrelevant to the former, he was working at the photography of sun-spot spectra, and at last succeeded in getting good images of double and triple lines. Forthwith the two researches met and flowed in the same stream; to test the magnetic hypothesis of the vortices he could examine the spot spectra polariscopically. Had either of these two lines of work been neglected, the other would have remained unfruitful. No doubt there was an element of luck in the simultaneity with which the two became available; but luck proverbially attends on energy and enterprise.

H. H. TURNER.

THE BRITISH SCIENCE GUILD.

THE fourth annual meeting of the British Science Guild was held at the Mansion House on March 18, when the fourth annual report upon the work of the past year was presented. The Lord Mayor occupied the chair, and an address was delivered by Mr. Haldane, president of the Guild. Sir John Cockburn, K.C.M.G., gave a summary of the report, the adoption of which was moved by Lord Strathcona, and seconded by Sir Alfred Keogh, K.C.B. Sir George Darwin, K.C.B., and Sir Ernest

[1] It does not seem to the present writer that the late Miss A. M. Clerke has been sufficiently careful to distinguish these two distinct steps in her otherwise admirable writings (see, *e.g.*, "Problems in Astrophysics," pp. 18 and 98.

Shackleton also spoke. We propose to print the main parts of these speeches later, and here limit ourselves to the mention of a few points of wide interest included in the report.

The following gentlemen were elected as new vice-presidents:—Sir William White, K.C.B., F.R.S., Sir Clifford Allbutt, K.C.B., F.R.S., Sir George Darwin, K.C.B., F.R.S., Surgeon-General Sir A. Keogh, K.C.B., Right Hon. Sir George Reid, K.C.M.G. The following new members of the executive committee were also elected:—Sir David Gill, K.C.B., F.R.S., Sir William White, K.C.B., F.R.S., the Rt. Hon. the Earl of Chichester, Sir A. Keogh, K.C.B., Mr. A. Mosely, C.M.G., Sir Boverton Redwood, Colonel Sir John Young, C.V.O.

The executive committee proposes to offer two prizes for an essay on "The best way of carrying on the struggle for existence and securing the survival of the fittest in national affairs." The essay should state the main points to which attention must be directed; the following, in which the practice of modern nations differs, may be touched upon:—

(1) The training of the citizen to secure national efficiency in peace, and national defence in war.

(2) State organisations for securing the same objects.

(3) The State endowment of the higher teaching and research in universities and elsewhere.

(4) Whether a system of party government alone is sufficient to secure all the best interests of the State in those directions in which brain-power and special knowledge are needed, or whether a body free from the influence of party politics and on which the most important national activities are represented by the most distinguished persons is desirable.

(5) Whether it is of advantage that the nation's greatest men in science, learning and industry on whom, in peace, the prestige and progress of the nation chiefly depend should be in touch with the head of the State.

(6) How discoveries and applications of science can be best and soonest utilised for State purposes both in peace and war.

Formation of Colonial Branches.

In the last annual report reference was made to the proposed formation of branches of the Guild in Australia and Canada. During the year further progress has been made, and inaugural meetings have been held in Winnipeg (Canada) and Sydney (New South Wales). A branch is also being formed in South Australia.

In Canada an organising committee has been formed, consisting of the leading educational, scientific, and business men. By forming such a committee, it was considered that not the least of the advantages would be the keeping in touch with the scientific methods throughout the Empire, and it was hoped that the Canadian committee might thus be the means of obtaining accurately for the British Guild information on Canadian matters.

The inaugural meeting of the New South Wales branch was held on October 13, 1909, at the Royal Society's House, Sydney, the Governor of New South Wales, Lord Chelmsford, occupying the chair. In the course of an address Lord Chelmsford said that what is wanted to-day, and what he thought the Guild intends to try to do, is to get a scientific spirit to permeate the public at large. Science is an end in itself; but the general public should be convinced that in giving money for scientific purposes they are giving it for a good cause, and also that scientific knowledge is worth something in pounds, shillings, and pence. He hoped in that way to get the public alive to the importance of scientific knowledge in everyday life. Departments of public instruction may bring forward schemes of coordination and the like, but until the parents have been convinced that education is of value to them, all the schemes in the world are not going to make them alive to education. In Germany and in America parents in the homes are alive to the importance of education, and they are determined to undergo any personal sacrifices if they can only give their sons and daughters the best possible education.

In the case of agriculture, we have to convince the farming community as a whole that there is something in scientific knowledge that is going to be of value to them. This is very hard to do. It is to be hoped that by its methods the Guild will be able to press home, not only upon men in authority—he believed men in authority are fully alive to the value of scientific knowledge—but also upon the men in the street, that scientific knowledge is not a mere abstraction, and that if devoted to commerce, trade, and everyday life, it will sweeten and enrich the lives of all and help the well-being of the community at large.

Speaking of the objects of the Guild, Dr. F. A. Bennet said that Germany spends more money on the University of Berlin alone than does England upon the whole of her universities put together. "It is not the German Dreadnoughts we have to be afraid of, but the German schoolmaster," observed Sir James Graham. "He is the man who is doing the damage."

In South Australia, the Governor, Sir Day Hort Bosanquet, is acting as patron of the branch. In a circular, issued by the secretary, the ideals of the Guild are stated as:—

"To give one kind of education only to the people of the Empire—*the best* (both practical and theoretical)—and to secure its economic application to the wants of mankind.

"To help us to keep our Empire the greatest factor in the world and retain our immense commerce. To do this we must teach the people the necessity of applying the methods of science to all branches of human effort. It must be observed that practical and scientific knowledge combined, and its application to useful purposes, is the secret of all human mental influence and power. It reduces labour, increases pleasure, and gives health and contentment.

"Scientific straight-thinking is just as good for us as a navy is for Germany. *Brains lie at the root of all things.*"

The Want of National Organisation.

The president of the Guild in his address last year remarked:—"The exertions of our people as a united people are necessary if we are to hold our own in the stress of the competition of nations." These remarks have led the executive committee to consider how best the suggested changes can be brought about. The committee points out that in the case of the armed forces of the country, following the example of Germany, a general staff for army purposes is already in being, and the Government has announced that a similar organisation is being established for naval purposes. The view that the peace purposes of the nation could be well served by an organisation dealing similarly with peace requirements, and indeed that they cannot be best served without it, is rapidly gaining ground, all the more because it is becoming fully recognised that party politics deal more with the temporary success of a party than with the permanent welfare of the State. A body composed of men selected from among the most eminent representatives of science, education, industry, commerce, and finance, associated with the technical heads of the Government institutions dealing specially with such matters, would provide such a general staff fully competent to deal with questions in which united action would be conducive to the nation's welfare and progress.

In university organisation there has been steady growth of opinion in two directions. First, the necessity for the fullest consideration of research in connection with all the higher teaching; and, secondly, the national loss which results from the exclusion of the universities from the Government view of education as represented by its Board.

In giving a statement of some scientific researches which have recently been aided by the State, the executive committee remarks that the present Government has shown itself more anxious to promote scientific inquiry than any of its predecessors.

Work of Committees.

New committees have been formed for dealing with the conservation of natural sources of energy, and to consider the question of technical education and its position in regard to universities. In addition to these, there are committees dealing with education, inexpensive instruments in science teaching, agriculture, synchronisation of clocks, naming and numbering of streets (executive committee), and the coordination of charitable effort.

The medical committee has been increased in numbers in order to take up specially the consideration of medical research. In its report this committee emphasises the very great importance of post-graduate medical study, and points out the very wide field and the great materials for such work which exist in London, and that owing to the absence of organised effort relatively little use is being made of this immense field. It is further considered that the ideal to be worked for is the establishment of a central medical school in connection with the London University, which should be devoted to post-graduate teaching and research. Such central school might be associated with all the London hospitals in connection with the London University for the purpose of post-graduate medical study, and should have affiliated to it other medical institutions and hospitals for the treatment of special types of disease (such as hospitals for epilepsy and diseases of the nervous systems, the Royal Ophthalmic Hospital at Moorfields, Brompton Hospital for Consumptives, &c.). Professors appointed by the Central London University School would be deputed to work at any of the appointed institutions, where special facilities might exist for research and post-graduate teaching in the subject dealt with by each professor. The committee is strongly of the opinion that much greater facilities should be given for medical research than exist at the present time, and that large funds should be furnished from public and private sources for such purposes. One of the objects on which expenditure is urgently required is in the endowment by the Central London University School of arrangements for pathological research at the medical schools.

The committee on the conservation of natural sources of energy, of which Sir William Ramsay is chairman, has decided to draw up reports on (1) coal, particularly in connection with its employment for smelting and other industrial purposes; (2) internal-combustion engines and oil engines; (3) atomic and interatomic energy; (4) the availability and quantity of natural oil and natural gas; (5) the heat of the earth; (6) availability of water-power; (7) forestry; (8) carburisation of coal at high and low temperatures; (9) solar power.

THE PROPOSED SCOTTISH NATIONAL ANTARCTIC EXPEDITION OF 1911.

A LARGE and enthusiastic meeting, organised by the Royal Scottish Geographical Society, was held in the Synod Hall, Edinburgh, on Thursday evening, March 17, to hear the plans of Dr. Bruce for his second Antarctic expedition. Prof. J. Geikie, F.R.S., president of the society, was in the chair, and was supported by a number of representatives of Scottish scientific bodies and others. The keynote of the meeting was that the aim of the expedition was to be throughout scientific. This was emphasised first of all by the chairman, who on that ground disclaimed the idea against which a needless protest had been put forth by the president of the Geographical Society of Berlin, that Antarctic exploration should be in any way reserved for any particular nation, and, in view of the immense field for scientific investigation in Antarctica, welcomed the friendly rivalry of all nations in carrying out that work.

Dr. Bruce then addressed the meeting, and before giving an account of his present plans, gave a brief sketch of the history of Antarctic exploration, laying special stress on the part that Scotsmen had borne in that work since Weddell set sail from Leith in 1823. It is hoped that the expedition now planned will leave Scotland about May 1, 1911, and reach Buenos Aires about June 20 of that year. About ten days later it will sail for Cape Town, pursuing a zigzag course, for the most part, between the parallels of 40° and 50° S., but including a visit to the Sandwich group in about 57° S., as well as to Gough Island. The purpose of this navigation will be to supplement the bathymetrical survey of the South Atlantic Ocean begun by the *Scotia* in 1902–4, and it is not expected that Cape Town will be reached before September 1. After refitting and coaling, the ship will sail once more for the Sandwich group, and thence to Coats Land, and seek for a place on or near that coast where it may be possible to land and erect a house, although from the experience of the previous expedition it is thought possible that it may be necessary to go so far east as Cape Ann in Enderby Land for that purpose. At some point in Coats Land, however, it is intended that a sledge-party of three, under the leadership of Dr. Bruce, shall land with the view of crossing to the Ross Sea by way of the South Pole. The ship, after landing a party of ten or twelve persons at whatever point they find suitable for the erection of a house, will proceed, by a route in as high a latitude as possible, to winter at Melbourne, taking soundings and carrying on deep-sea research all the way.

In the following spring the ship will leave Melbourne and push southward to McMurdo Strait, Victoria Land, in order to send a sledge party to meet, and furnish with fresh supplies, the previously landed sledge-party under Dr. Bruce. It is expected that the two parties will meet near the Beardmore Glacier, and, after meeting, the combined party will proceed to the ship and sail for New Zealand. Further oceanographical work will afterwards be carried on between New Zealand and the Falkland Islands in as high a latitude as the winter season will permit, and in the following spring the ship will sail southwards to relieve the wintering party, which by that time will have been engaged for two years in surveying the coast-line of Antarctica east and west of the station, and in taking meteorological, magnetic, and other observations. The total cost of the expedition is estimated at about 50,000*l*. Dr. Bruce, it may be mentioned, is in cordial correspondence, not merely with Captain Scott, but also with the promoters of the German expedition, and there is good reason to hope that if funds are raised both for his and the German expedition, there will be no useless overlapping of work. As regards the McMurdo Strait, which Captain Scott has chosen for his special sphere of work, Dr. Bruce expressly announces that the Scottish expedition will make no special investigations in that region.

The meeting was then addressed by Dr. John Horne, F.R.S., director of the Geological Survey of Scotland, who, as representing the Royal Society of Edinburgh, first referred to the high value of the publications already issued giving the scientific results of Dr. Bruce's previous Antarctic expedition, including upwards of twenty papers published by the society he represented, and expressed the hope that the Government would see its way to furnish the necessary funds for the publication of the remaining results, which were eagerly looked for by all interested in Antarctic exploration in every part of the world. He stated that he was commissioned by the council of the society to give to Dr. Bruce's new scheme the most cordial recommendation to the Scottish public for financial assistance.

Prof. J. Graham Kerr, F.R.S., professor of zoology in the University of Glasgow, then spoke as representative of the Royal Philosophical Society of Glasgow, expressing that society's cordial sympathy with Dr. Bruce's project, and especially because they felt that they had in him a splendid example of the type of explorer who, while ready to take any adventures that came his way, recognised that his real object was to do honest scientific work. The Earl of Cassilis, representing the St. Andrew Society, dwelt

more particularly on the contrast presented by the large grants that had been made by Government to other Antarctic expeditions, and the entire lack of recognition, so far, of the work of proved value that had been done by Dr. Bruce.

Prof. J. Cossar Ewart, F.R.S., professor of zoology in the University of Edinburgh, then commented on the zoological value of Dr. Bruce's expeditions, which had been the means of adding dozens of new species to scientific knowledge, and on that account gave his cordial support to the carrying out of this second Scottish Antarctic Expedition. In an eloquent speech Prof. D'Arcy W. Thompson, C.B., of the Scottish Fishery Board, professor of zoology in University College, Dundee, expressed warm appreciation of the work that Dr. Bruce had already done in his previous expeditions. Mr. Chisholm, lecturer on geography, Edinburgh University, recommended Dr. Bruce's plans to the support of the meeting, among other grounds, on account of the fact that Dr. Bruce had shown his qualifications as a leader by the attachment and devotion which he inspired in his followers, and this point was immediately enforced by Dr. R. N. Rudmose Brown, lecturer on geography in the University of Sheffield, who had accompanied him in expedition after expedition.

At the close of the meeting, on the motion of Mr. W. G. Burn-Murdoch, a resolution asking the meeting, as a representative Scottish gathering, to express their hearty desire to have Dr. Bruce's plans carried out, was unanimously approved. It should be added that, while the opinion that it was the duty of the Government to contribute to the publication of the results of the *Scotia* expedition was very freely expressed at the meeting, the appeal for funds to carry out the present projected expedition is not made, in the first instance at least, to the Government, but to "the enthusiasm and patriotism of Scots at home and abroad."

PROF. J. CAMPBELL BROWN.

As recorded with regret last week, Prof. James Campbell Brown, professor of general chemistry at the University of Liverpool, died very suddenly from heart failure on Monday, March 14. Prof. Campbell Brown, who was the son of the late Mr. George Brown, a chemical manufacturer with a business in London, was born in Aberdeenshire in 1843. He studied at the University of Aberdeen, and afterwards at the Royal College of Chemistry and the Royal School of Mines, London. He was a D.Sc. of London University, and LL.D. (*honoris causa*) of the University of Aberdeen. His connection with Liverpool began in 1867, when he was appointed lecturer in chemistry and toxicology at the Royal Infirmary School of Medicine. He became public analyst for Liverpool in 1872, for Cheshire and the Isle of Man in 1873, and for Lancashire in 1875. In 1877, being then chairman of the Royal Infirmary School of Medicine, he took a prominent part in the movement for the foundation of a university college in Liverpool, and from 1878 to 1884 was one of the secretaries of the special committee which afterwards became the council of the new college. Prof. Campbell Brown may, therefore, rightly be said to have been one of the prominent founders of the present University of Liverpool. In 1881 he was appointed to the chair of chemistry endowed by Mr. Grant, of Rock Ferry. When death overtook him he was still the active occupant of this chair.

For more than forty years Prof. Campbell Brown exercised an important and beneficial influence on higher education, and especially higher scientific education, in this country. In Liverpool in particular he developed a flourishing department of chemistry, and was very successful in enlisting the sympathy and obtaining the aid of the chemical manufacturers of Lancashire and Cheshire. As a public analyst of experience and repute he did much for the improvement of our methods of suppressing the falsification and adulteration of foods and drugs.

In 1874 he published a report on the chemistry of tea cultivation in India, and made important recommendations which proved of great value to that industry.

He contributed a very considerable number of papers to the scientific journals, and was awarded two gold medals by the Franco-British Exhibition. In this connection his excellent work on the latent heats of evaporation of liquids deserves special mention. Quite recently he contributed a paper to the Chemical Society dealing with double and triple ferricyanides.

In 1908 he was elected a vice-president of the Chemical Society. A man of genial, kindly, and unselfish nature, his heart was entirely in the work to which his life was devoted. He lived to see his labours crowned with a well-deserved success. The University of Liverpool owes him a debt of gratitude which few can appraise, and it stands to-day a memorial of his wisdom and foresight, his marvellous power of organisation, and his profound belief in the value of the investigation and dissemination of knowledge and truth.

F. G. D.

NOTES.

SIR WILLIAM RAMSAY, K.C.B., has been nominated "Membre d'Honneur"—honorary member—of the Chemical Society of France.

SIR THOMAS BARLOW, F.R.S., has been elected president of the Royal College of Physicians, London, in succession to Sir Richard D. Powell.

THE Aldred lecture of the Royal Society of Arts will be delivered by Prof. H. H. Turner, F.R.S., on Wednesday, May 4. The title of the lecture is "Halley and his Comet."

THE death is announced, in his seventy-second year, of Dr. Otto Hermes, founder of the Berlin Aquarium. Dr. Hermes was appointed director of the aquarium in 1871, and was known by his writings on zoological subjects.

AMONG the latest developments of Germany's airship movement we notice the fund raised by Prince Henry of Prussia for the building of a dock at Hamburg capable of housing at least two Zeppelins. Of the 50,000*l.* required, 20,000*l.* was raised almost immediately.

A YOUNG horn of *Cervus megaceros* has been dug up recently from a depth of 2 or 3 feet below the surface of Martin Mere, near Southport, in Lancashire. It is the property of the Rev. Mr. Bulpit of that town, by whom the specimen has been submitted for determination to the director of the Liverpool Museums.

THE following awards of the Royal medals and other honours have been made by the council of the Royal Geographical Society:—Royal gold medals: founder's medal, Colonel H. H. Godwin Austen, C.M.G., F.R.S.; patron's medal, Dr. W. S. Bruce; Murchison grant, Dr. Carl Skottsberg; Gill memorial, Mr. D. Carruthers, for his journey in north central Arabia; Cuthbert Peek grant, Lieut. C. E. Fishbourne, R.E.; Back bequest, Mr. H. Vischer. A special medal has been awarded to Rear-Admiral Peary for his attainment of the North Pole.

By the death of Prof. J. Edmund Wright, of Bryn Mawr College, a young mathematician of great promise has been lost. Prof. Wright graduated at Trinity College, Cambridge, being senior wrangler in 1900, subsequently taking a first in "part two" and obtaining a Smith's prize. He was in 1903 appointed associate professor in Bryn Mawr College, in succession to Prof. Harkness. He was the author of a "Cambridge Tract" on "Invariants of Quadratic Differential Forms," and he also wrote on theory of groups, differential geometry of space, and Abelian functions.

SIR FREDERICK MAPPIN, BART., whose death at the age of eighty-nine years took place on March 19, was an active friend of higher education in Sheffield. He took a very prominent part in founding the Sheffield Technical School, which later formed an important part of the University College, and is now merged in the University of Sheffield. He contributed generously towards the support of these institutions, and at the time of the foundation of the University gave 15,000*l.* to its fund. He was one of the first two Pro-Chancellors of the University, and was also chairman of its department of applied science.

AN International Hygiene Exhibition is to be held in Dresden next year. At a meeting of members of the British executive committee of the exhibition, held on March 16 at the Hotel Cecil, Prof. Pannwitz, the deputed representative of the scientific department, delivered an address. He explained the aims and objects of the exhibition, the support which is being extended by the German Imperial and State Governments, the efforts which many civilised countries are making to secure an effective representation, and he concluded by expressing his full confidence that the British representation will be in every respect worthy of the country which is the acknowledged birthplace of sanitary science. Offices are to be opened in Victoria Street, S.W., for the accommodation of the British executive and for the general working of the undertaking in this country.

THE sixty-third annual meeting of the Palæontographical Society was held at Burlington House on Friday, March 18, Dr. Henry Woodward, F.R.S., president, in the chair. The report of the council referred to the progress of the monographs on Pleistocene Mammalia, Cretaceous and Carboniferous fishes, and Cretaceous Lamellibranchia, and recorded the gift of a series of plates of Carboniferous fishes by the Carnegie Trust for the universities of Scotland. It lamented the death of two members of council during the past year, the Rev. G. F. Whidborne and Mr. C. Fox-Strangways. Miss M. S. Johnston, the Rev. R. Ashington Bullen, Dr. F. L. Kitchin, and Mr. A. W. Oke were elected new members of council. Dr. Henry Woodward, Dr. G. J. Hinde, and Dr. A. Smith Woodward were re-elected president, treasurer, and secretary respectively.

FROM the *Deutsche Zeitschrift für Luftschiffahrt* we learn with deep regret of the death of the founder and editor of that journal, Lieut.-General H. W. L. Moedebeck. The name of Moedebeck figures prominently in the annals of German aëronautics, and even the published records which reach this country afford evidence of the powerful influence of his personality in stimulating aëronautical enterprise. He is described as a man possessing ideas, not only for the requirements of the day, but for developments of the future. Before airships were thought of he devised methods of preventing explosions in motors, and his geographical surveys were also initiated, in the face of considerable opposition, before the demand for them had arisen in connection with aërial navigation. In 1884 he was first appointed by the German Government to develop the balloon for military purposes. He has published a handbook and a pocket-book of aëronautics, of which the latter is now well known in this country. His works on "Airships: their Past and Future," and on flying men, have done much to popularise aëronautics; but perhaps the two things which stand out most prominently as his life-work have been the *Deutsche Zeitschrift* and the aëronautical map brought out in connection with the above-mentioned survey. The part which Moedebeck played in developing the "Zeppelin movement," especially at a time when the Count had few supporters, is also worthy of note.

NEARLY thirty years ago, the sanction of Parliament was given to a scheme to obtain an adequate water supply for Liverpool from the Welsh hills. This undertaking was completed on March 16, when the Prince of Wales visited Lake Vyrnwy and turned on into the great artificial lake there the water collected from the Marchnant River. The complete scheme for the water supply of Liverpool outlined by Messrs. G. F. Deacon and T. Hawksley comprised the impounding of the rivers Vyrnwy, Marchnant, and Afon Cownwy. The two latter are higher than the former, and the work in connection with them was carried out after the Vyrnwy scheme was finished. In the cases of Afon Cownwy and Marchnant the rivers were dammed, and tunnels cut through the intervening hills so that the impounded water could empty itself into the Vyrnwy. The Afon Cownwy tunnel was 7 feet in diameter and 6723 feet in length, and the Marchnant tunnel 7 feet in diameter and 7345 feet in length, and it was at the latter one that the Prince of Wales opened the valve which allowed the water to flow through the tunnel into the Vyrnwy lake, thus completing the whole scheme. The completed scheme as it now stands has a gathering ground of 22,742 acres, and the capacity of Vyrnwy lake is 12,131 million gallons; its greatest depth is 84 feet; the area of its surface is 1121 acres, and its length $4\frac{3}{4}$ miles. The surface-level of the lake above the sea is 825·89 feet Ordnance datum, and the level of the highest point in the watershed is 2050 feet Ordnance datum. The water engineer of Liverpool, Mr. Joseph Parry, has been entirely responsible for the work in connection with the Marchnant and Afon Cownwy rivers.

THE last Bulletin, that for March 10, of the Institution of Mining and Metallurgy contains the annual report of the council, which deals with the work of the year 1909. The gold medal of the institution has been awarded to Prof. William Gowland, F.R.S., in recognition of his services in the advancement of metallurgical science and education during a long and distinguished career. "The Consolidated Gold Fields of South Africa, Ltd.," gold medal has been awarded to Mr. W. A. Caldecott, in recognition of his work in the investigation of methods of reduction and treatment of gold ores and of his contributions to the literature of the subject. "The Consolidated Gold Fields of South Africa, Ltd.," premium of forty guineas has been awarded conjointly to Messrs. C. O. Bannister and W. N. Stanley, for their work in the investigation of the thermal properties of cupels and for their joint paper on "Cupellation Experiments—the Thermal Properties of Cupels." Four post-graduate scholarships, each of 50*l.* in value, have been awarded. The total membership of the institution at the end of the year under review was 1902, which represents an actual increase of 277 in two years.

German geology has sustained a serious loss by the death of Dr. Emil Philippi, extraordinary professor of geology at Jena, who is best known as the geologist with the German Antarctic Expedition under Prof. von Drygalski. He had been from 1901 to 1906, except during his absence with that expedition, a privat-docent in Berlin. In 1906 he was called to Jena to succeed Prof. J. Walther as assistant to Prof. Lenck. Dr. Philippi will be best remembered by his contributions to the geology of the Gaussberg, beside which the *Gauss* wintered in the Antarctic; they and his memoir on the islands visited on the voyage have been reviewed in Nature. His other contributions are mainly on problems connected with glacial geology. He was especially interested in facetted stones, which he discovered both in the drifts of north Germany and in Antarctic icebergs. He seemed disposed to regard facetted stones in general as due to ice work. He published in 1908 a short memoir on the Upper Palæozoic glaciation of southern Africa and Australia, for which he accepted a Permian date. He accompanied the Geological Congress in its excursion to Mexico in 1906, and subsequently wrote an account of the tectonic effects of the intrusion of the syenite porphyry of Cerro Muleros. His premature death in Egypt has cut short a career of great promise.

The Premier (Transvaal) Diamond Mining Company recently presented to the British Museum (Natural History) an interesting series of specimens from the Premier Mine, near Pretoria. The examples of diamondiferous rock which come from different depths, ranging from 15 to 160 feet below the surface, exhibit very clearly the change that takes place in the colour and texture as the depth increases; the specimen, orange in colour and powdery in character, which came from the shallowest depth, is in marked contrast with that, bluish and hard, which was taken from the lowest depth. The series of rough diamonds, eighteen in number, and nearly 9 grams, or 29 carats, altogether in weight, gives an idea of the variation possible in the form, transparency, and colour of the stones found in the mine; thus there are a clear white octahedron and a black opaque boart, a tetrakis-octahedron, nearly spherical in shape, and a flat, triangular twin, and yellow, pink, and brown stones. Examination in polarised light shows that most of the diamonds are in a state of strain. A specimen of "blue ground" out of which emerges a diamond is of especial interest, because it so rarely happens that the rock is split just where a diamond chances to be. The series includes also specimens of the associated minerals, pyrites, calcite, and "Cape-ruby" (pyrope-garnet).

Great efforts are being made by the committee, of which Lord Desborough is chairman and Mr. C. E. Fagan secretary, to render the British big-game section at the forthcoming Vienna Sports Exhibition a success. His Majesty the King, who has given directions that the skeleton of his famous thoroughbred Persimmon should be sent, is taking great personal interest in the matter; and the trustees of the British Museum have placed the services of a portion of the staff of the Natural History Branch at South Kensington at the disposal of the committee. One of the special objects of this section is to exhibit a representative series of trophies of the big-game animals found in the British Empire (inclusive of protected States). The number of such species, according to a provisional list drawn up for the committee by Mr. Lydekker, is about 165, but many of these are represented by two or more local races. A number of sportsmen and other owners of trophies of this nature have been asked to lend specimens, especially those approaching or representing the "record," and the replies have been, on the whole, of an encouraging nature, the names of those who have promised to lend specimens including the King, the Prince of Wales, the Duke of Westminster, Lord Lansdowne, Mr. Chas. Lucas, and a number of well-known big-game sportsmen. It is also intended to exhibit specimens of the game mammals, birds, and fishes of the British Isles. A photograph of the picturesque building intended for the reception of the British trophies appears in the *Field* of March 19, accompanying a letter from Lord Desborough. The main difficulty is the shortness of the time available, the exhibition opening in May.

When the Aërial League was founded, an excellent opportunity was afforded to the British public to retrieve the reputation implied in the words "England's Neglect of Science"; but in an article in the *Standard* (March 14) Captain Cave Browne Cave draws a striking comparison between the support which this movement has obtained and the reception accorded to similar efforts abroad. He says:—"In Germany up to last year the public had subscribed 330,000*l.* towards the building of an aërial fleet. The Government has made grants amounting to 250,000*l.* The Aërial League, founded in 1908, has attained a vast membership; a practical school of aëronautics has been founded at Friedrichshafen, and a chair of aëronautics at Göttingen University; the wharves, docks, aluminium foundry, hydrogen factory, and large construction yards which have been built at Friedrichshafen are capable of turning out six complete Zeppelins annually, while the output of Gross, Parseval, and other equally successful types of military dirigibles is practically unlimited. In France Government lands have been placed at the disposal of pioneers of flight; great public subscriptions have been raised. Prominent men like Messrs. Deutsch, de la Meurthe, Basil, Zaharoff, and Archdeacon have come forward from time to time with munificent gifts, aggregating over 100,000*l.*, for the foundation of aërotechnical institutions, for scientific research work and tuition in aëronautics, for special prizes and the encouragement of inventors. A college of advanced aëronautics has been inaugurated at Paris for the theoretical and practical training of aviators. The French Aërial League, with a membership well over 10,000, has courses of study and practical work at its Juvisy flying ground. In England the Aërial League has been formed, but the appeal to the British people has produced little result."

We regret to record the death, on March 6, of Mr. Charles Fox-Strangways. Born in 1844 at Rewe, near Exeter, where his father, a grandson of the first Earl of Ilchester, was rector, Mr. Fox-Strangways was educated at Eton and afterwards at Göttingen, where he studied mineralogy, chemistry, and physics. In 1867 he was appointed an assistant geologist on the Geological Survey under Murchison, and was engaged for some years in mapping parts of the Yorkshire coal-field, the country around Harrogate, and a large area extending across the Vale of York to the Jurassic and Cretaceous rocks of the east Yorkshire moorlands, and the coast near Scarborough. He was author, or part author, of several memoirs, notably one on the geology of Harrogate, of which a second edition was published in 1908. His chief publication was a general memoir on the Jurassic rocks of Yorkshire, published in two volumes, 1892. In 1889 Mr. Fox-Strangways was transferred to the Midland district, residing for many years at Leicester while engaged in surveying the Leicestershire coal-field and bordering areas. He was author of

memoirs on that coal-field, and on the country around Derby, Burton-on-Trent, Atherstone, Charnwood Forest, and Leicester. In 1901 he was promoted to be district geologist, but retired from the public service in 1904, as a weakness of the heart, which ultimately proved fatal, rendered it necessary to give up the arduous work of a field-geologist. His geological labours, represented by official maps, sections and memoirs, and by papers communicated to scientific societies, bear evidence of the most painstaking care and accuracy. While at Leicester Mr. Fox-Strangways did much to promote local interest in geology, especially by conducting field-excursions, which were highly appreciated.

According to a telegram from Paris in the *Times* of March 13, an International Congress for the Study of Cancer will be held in that city, under the patronage of the President of the Republic, in the first week of October. The assemblage will not be a congress in the true sense; its official title is "Second International Conference for Cancer Research," the first meeting of the kind having been held in Heidelberg in 1906, as the outcome of which a sort of international association has developed. From this association, however, British investigators have hitherto held aloof, notwithstanding efforts that have been made from Berlin to induce the Imperial Cancer Research Fund—which is the national and representative body in this country—to join. These efforts have taken the form of questions addressed to the Prime Minister in the House of Commons, and even went so far as the presentation of a petition to the King during his visit to Berlin in February, 1909. The German organisers of the so-called international association have used their best efforts to have the first International Congress on Cancer held in London in 1910; but this proposal was discountenanced by the director of the Imperial Cancer Research Fund, Dr. E. F. Bashford, and the executive committee, on the ground that the time for such a congress had not yet arrived. It was felt that such a congress held in London under the auspices of the Imperial Cancer Research Fund, backed as it is by the support of various Government departments, the Royal Society, the Royal Colleges of Physicians and Surgeons, and other public bodies, would arouse too great expectations on the part of the public. The programme for the forthcoming meeting in Paris covers a wide range of subjects, but in the absence of the names of those contributing papers it is too early to decide what importance will attach to the assembly. The list of office bearers given in the *Times* exhibits the remarkable feature of not including a single name of an active worker in those fields of cancer research which are the direct contributors to the success attending the investigations of the past ten years. However distinguished some of these names are in the realms of practical medicine and surgery, they add little, if any, weight to the purely scientific side of an assembly called together to study so recondite a problem as cancer.

Dr. Luigi Pernier, under the title of "Vestigia di una Citta Ellenica arcaica in Creta," has issued, through the Istituto Lombardo di Scienza e Lettere, an account of a summary examination of an early Greek city in Crete. It is surrounded by walls of cyclopean masonry, now partially ruined. Some inscribed stones and terra-cottas were discovered, the most interesting find being a stele representing a standing figure facing to the right, clad in a tightly folded robe, and holding in the left hand something resembling the Egyptian Ankh. The figure possibly shows the influence of Minoan traditions, and the site clearly deserves further detailed examination.

Major Lamb, I.M.S., and Captain McKendrick, I.M.S., detail certain observations on rabies in the Scientific Memoirs of the Government of India (No. 36). They find that when the "natural" virus is passed through dogs a "fixed" virus is obtained just as with rabbits, and that the structures known as "Negri bodies," while easily demonstrable in the natural virus, cannot be found in the fixed virus. In several cases, both in dogs and in rabbits, a chronic form of rabies was observed, the chief symptom of which was progressive emaciation. It is comparatively easy to infect guinea-pigs and monkeys by subcutaneous inoculation of the virus. As in monkeys the incubation period is much prolonged when the inoculation is subcutaneous, attempts were made to immunise these animals with a single subcutaneous inoculation with a fixed virus, but without success. No bacteriolytic properties towards the virus could be detected in the serum of patients who had undergone the anti-rabic treatment.

Fisheries, Ireland, Sci. Invest., 1908, iv. (1910), is devoted to an account, by Messrs. E. W. L. Holt and L. W. Byrne, of the chimæroid fishes of the Atlantic slope off the west coast of Ireland. The most interesting of these is *Rhinochimaera atlantica*, a long-beaked species known by a single adult male captured at a depth of between 670 and 770 fathoms, and certain egg-capsules attributed to the same species, which was first named by its describers in 1909. *R. atlantica* belongs to a genus otherwise represented by *R. pacifica*, distinguished by the relative shortness of the base of the second dorsal fin. The only Atlantic chimæroid with which *R. atlantica* could be confounded is *Harriotta raleighana* of the western Atlantic; the largest of the four known specimens of the latter is, however, not more than half the size of the type of the former, which, in turn, is decidedly smaller than its Pacific representative. Harriotta is also otherwise distinguished.

In the thirteenth quarterly report on the scientific work of the Lancashire and Western Sea-fisheries, Mr. J. Johnstone refers to experiments carried out at Conway in regard to the cleansing of mussels from sewage-pollution. By transplanting the mussels to pure water, about 90 per cent. of the sewage-bacteria was eliminated, from which it appears that it will be possible to render the polluted molluscs of the Conway estuary fit for human consumption at a comparatively small cost. In the fourteenth report Mr. Johnstone dwells on the measurements of plaice which have been made during the last two years, these relating to something like 100,000 individual fish. These lead to the provisional conclusion that, in spite of the enormous numbers of under-sized fish taken by this method, the 6-inch trawl-mesh is not harmful to the plaice-fishery. "The plaice are small and below the normal in 'condition' because they are so abundant. If they could be 'thinned out' by transplantation it might be of advantage to the fisheries in general to enforce the 7-inch mesh; but so long as they cannot be transplanted I do not think that the use of the larger mesh would lead to any improvement, and it would certainly diminish the takings of the inshore fishermen."

Various attempts have been made from time to time to interpret the phenomena of sex-determination in accordance with Mendelian principles. The problem is again attacked by Mr. Geoffrey Smith in the first of his "Studies in the Experimental Analysis of Sex," published in the *Quarterly Journal of Microscopical Science* for February. Some years ago this investigator was led to formulate a Mendelian interpretation of sex-inheritance as a result of his remark-

able observations on the parasitic castration of the crab Inachus by the degenerate barnacle Sacculina. Male crabs when infected by the parasite develop the secondary sexual characters of the female, and in certain circumstances ova may actually appear in the gonad. Female crabs in like case, however, do not develop male characteristics. Hence it was concluded that the male crab is a potential hermaphrodite, in other words, a heterozygote in which, under normal conditions, maleness is dominant. The female crabs, on the other hand, were regarded as pure recessives in respect of their femaleness. On these facts, amongst others, the author bases his "half-hybrid" theory of sex-inheritance, in accordance with which one sex is a heterozygote showing dominance of maleness or femaleness, while the other is a pure recessive homozygote. It appears that Prof. Bateson and Mr. Punnett two years later arrived independently at the same result in endeavouring to interpret Doncaster's remarkable breeding experiments on the currant moth, but in this case the female is the heterozygote and the male the homozygote. Mr. Smith also deals with the correlation between primary and secondary sexual characters, again largely as a result of his own observations on the parasitic castration of Inachus. He concludes that the development of the secondary sexual characters is not primarily dependent on the gonad, but that the development of both is dependent upon a common factor, which is supposed to be a hypothetical "sexual formative substance," an internal secretion, occurring in two varieties, male and female. The theory, however, is somewhat complicated by the necessity of taking into consideration the well-known effect produced by the gonad on the development of the secondary sexual characters, as shown by castration. Mr. Smith's views on the question approximate closely to those of Mr. Walter Heape.

A CURIOUS abnormality in a batch of crocus specimens is described in the *Gardeners' Chronicle* (February 26). Some of the thin scale leaves that envelop the bud had developed into white fleshy leaves, which grew nearly as high as a normal flower, while the enclosed foliage leaves and flowers were stunted. It is suggested that the sap had been diverted to the scale leaves as a result of forcing treatment.

THE treatment of felled trees with the view of reproduction by coppice shoots forms the subject of an article in the *Indian Forester* (December, 1909). In Europe it is usual to cut the stumps flush with the ground. When this method has been followed in India, at any rate in the case of the well-known sál tree, *Shorea robusta*, coppice shoots are in many cases not formed at all; it appears that, owing to contraction, the wood and bark separate, and the dormant buds are not rejuvenated; but if a few inches of the stump are left, coppice shoots are abundantly produced.

WITH regard to the ultimate reasons for the injurious effects produced in plants by frost, an instructive article appears as an editorial in the *Gardeners' Chronicle* (February 19). It has been shown that ice is first formed in the interspaces between the cells, with the result that water is withdrawn from the cell sap; continued formation of ice causes disruption of the tissues; but ice-formation is not regarded as the chief cause of injury. A new theory receiving the approval of competent authorities has been advanced by the Swedish botanist Lidfors. He examined a number of plants such as Cerastium and Viola, which, without any apparent means of protection, survive the severe winters of Sweden, and found that during winter the starch in the leaves was replaced by sugar. He then falls back on experiments connected with the maintenance of proteins in the cell sap and protoplasm, by which it has been shown that if water be extracted from the cell the proteins pass out of solution, causing destruction of the cell; but if sugar is present the proteins will remain in solution until a much lower temperature is reached. This theory also affords a logical explanation of the disastrous effects of spring frosts.

THE official forecast for the wheat crop of South Australia is now published in the *Journal of Agriculture* for that colony, and is put at $11\frac{1}{3}$ bushels per acre. If this is realised it will be the second highest yield during the last twenty years. The average yield in 1893 was 7·5 bushels per acre; it fell steadily until 1896, when it was only 1·4 bushels, but then it rose slowly to 11·3 bushels in 1905 and has remained round about this figure since. The 1908 crop of 11·45 bushels was the highest on record. The yield for the United Kingdom in 1908 was 32·3 bushels.

IT occasionally happens that milk which has stood at low temperature for twelve to twenty-four hours becomes so viscid that it can be drawn out into strings. The trouble is caused by a micro-organism, but as it is not very common no large number of investigations have yet been made. A case that arose in Rhode Island was fully investigated by Messrs. Cole and Hadley, the results being published as Bulletin 136 of the Rhode Island Agricultural Experiment Station. From the details given it appears that the organism resembles the *Bacillus lactis viscosus* described by Adametz and A. R. Ward, and belongs to the same group.

MR. H. T. FERRAR contributes further notes on the movements of subsoil waters in Egypt to the December (1909) number of the *Cairo Scientific Journal*. These deal specially with the variations of level observed in a number of experimental tube-wells specially set up in the province of Gharbia, in Lower Egypt, which indicate that the conditions in Lower Egypt are almost the reverse of those which obtain in Upper Egypt, the minor factors in the latter becoming the controlling factors in the former. A series of diagrams shows the relation of the Nile flood to the movements of water-table, with the modifications produced by such factors as the nature of the soil, seepage, and irrigation.

CAPTAIN TIXIER, of the Siam Indo-China Boundary Commission, contributes to *La Géographie* (xx., No. 6, p. 337) a valuable note on the orography of French Indo-China. The region may be described generally as a vast sandy plateau, uplifted towards the east and enclosed by four folds in parallel pairs perpendicular to each other. On the north the Tonkin and northern Annam fold runs north-west and south-east, with a parallel member, much less important, to the south, in the Cardamom range. At right angles to these, in a direction N. 25° E., are the Cape Varela-Poulo Condore chain and the great fold which appears to have rested its whole weight on the sand plateau, causing it to sink, and in balancing to rise to the east, the movement being accompanied by fracture in two directions parallel to the enclosing chains. The Gulf of Siam, with its almost uniform depth of 45 metres, is apparently a plain similar to that of Grand Lac and the Semoun.

WE have recently received an excerpt from the Bulletin of the Society of Historical and Natural Sciences of the Yonne (2 Semestre, 1908), consisting of a very useful

and laborious compilation by M. Ernest Blin of *Remarques météorologiques* made in various districts of that department between the fifteenth and eighteenth centuries. The notices are taken from the archives of various institutions and from provincial publications, and are arranged in chronological order, with references to the sources of origin, and furnish much information on the general character of the seasons and on conspicuous meteorological occurrences, floods, &c. Some interesting references are also made to the former practice of ringing church bells with the idea of dispersing hail and thunderstorms; this practice was still in vogue at Quarré-les-Tombes until the middle of the nineteenth century. The publication of this summary is due to a suggestion by M. E. Lauda, of the Austro-Hungarian Hydrographical Service, and recommended by the Meteorological Conference at Innsbruck in 1905, that all available historical documents of different States regarding abnormal weather phenomena should be collected and published.

IN November last Mr. J. W. Giltay and Prof. M. de Haas communicated to the Koninklijke Akademie van Wetenschappen te Amsterdam an interesting paper, a copy of which has just reached us, on the motion of the bridge of the violin. Various statements as to the nature of the movement have been made by writers on acoustics, such as Helmholtz, van Schaik, Apian-Bennewitz, Barton, Garret, and Pentzner, but, by ingenious experiments, Giltay and de Haas have conclusively proved that the motion of the bridge is in two directions, namely, (1) in its own plane about one of the feet and at right angles to the strings, and (2) at right angles to its plane, or transversely, that is, in the same direction as the strings. The sound of a violin must be attributed to three causes:—(*a*) a vibration imparted to the air by the string; (*b*) a vibration which the roof of the violin receives from the parallel swing of the bridge; and (*c*) a vibration communicated to the roof by the transverse vibration of the bridge. The (*a*) movement may be left out of account as being very weak, and the intensity and timbre of the note is determined by the parallel and transverse motions, and more especially by the latter. Each of these motions has its fundamental tone and associated partials, and the quality of the tone is modified when the intensity of one of the motions alters its partials, while it may leave the other motion unchanged or slightly changed. A "mute" damps the transverse motion of the bridge to a higher degree than the parallel motion, and the use of the mute does not weaken intensity so much as to alter quality.

THE February number of the Johns Hopkins University Circular consists mainly of notes from the physical laboratory of the University, edited by Prof. J. A. Ames. One of the most interesting of the notes is that of Mr. J. A. Anderson, on a method of testing screws intended for the most accurate work, such as the ruling of diffraction gratings. A nut which fits the screw accurately is cut in two by a plane through its centre perpendicular to its axis, and the two parts rotated through an angle of 180°, for example, with respect to each other. One of the plates of a Fabry and Perot interferometer is mounted on each half of the nut, and the motion of the interference fringes observed as the screw is rotated by hand at a convenient speed, the two parts of the nut being prevented from rotating with respect to each other. The method is more sensitive than that of the late Prof. Rowland, which consisted in ruling two sets of grating lines at a small angle to each other and observing the loci of the intersections of the two series of lines.

THE *Electrician* for March 4 contains a short article by Dr. W. H. Eccles on the radiation from directive aërials in wireless telegraphy, in which the problem is treated by the exponential method, which has done so much to shorten the mathematical work in modern treatises on light. If the disturbance at the point of observation due to an aërial at a distance x is represented by $re^{i(u+a)}$, where u is a linear function of x and of the time, that from another aërial at a distance d from the former in a direction which makes an angle ϕ with the line joining the point of observation to the first aërial can be represented by a similar expression, with r and a omitted and u decreased by $2\pi d.\cos\phi./\lambda$. The total disturbance at the point of observation due to the two aërials can then be represented by $e^{iu}(re^{ia}+e^{-i2\pi d.\cos\phi/\lambda})$. The energy received is the square of the modulus of this, that is,

$$r^2+1+2r\cos(a+2\pi d.\cos\phi./\lambda).$$

This expression, plotted as a function of ϕ, gives the polar diagram of the directive system, the form of which depends greatly on the value of $2\pi d/\lambda$. The directions in which the radiation from the aërials is a maximum for a given value of a, the relative phase, are independent of r, the ratio of the amplitudes of the oscillations in the two aërials.

ALTHOUGH users of glass apparatus are familiar with the general appearance of the breaks which sometimes occur, no one has hitherto made a scientific study of their forms in relation to their causes. In the *Physikalische Zeitschrift* for February 15 there is a paper by Dr. L. Gabelli which remedies this omission. Breaks are classified as due either to external or to internal causes. The external causes may be localised, as in the case of a blow struck on the surface of the glass with a pointed or blunt object, or be distributed over the surface, as in the case of hydrostatic pressure. The author shows by means of numerous figures that in each case the break has characteristics which enable the cause to be assigned, and in the case of hollow vessels there is a difference between the effects due to the same cause applied within or without. Of breaks due to causes within the material, those which fall under unequal heating are most common, and, like the previous ones, have their own characteristics, which depend greatly on the distance of the heated point from the edge of the material. The author hopes that the technical importance of the subject will lead others to continue these investigations.

WE learn from a note in *Engineering* for March 18 that the Bureau Veritas International Register of Shipping will shortly issue a new edition of its rules. The new publication will be very comprehensive. No change has been made in the method of determining the scantling numerals, which remain as formerly, the basis being the sum of the breadth and depth, and the product of the length, breadth, and depth. For thickness of material, one-fiftieth of an inch has been adopted as a unit, instead of one-thirty-second as formerly. This will admit of ready comparison with the British standard decimal system on the one hand and with the metric system on the other.

MESSRS. WILLIAMS AND NORGATE will issue very shortly, in conjunction with Messrs. B. G. Teubner, of Leipzig, a volume compiled and edited by Yokshio Mikami, entitled "Mathematical Papers from the Far East."

MESSRS. WATTS AND CO. have issued for the Rationalist Press Association, Ltd., a cheap reprint of "The Nature and Origin of Living Matter," by Dr. H. Charlton Bastian, F.R.S. This edition has been revised and slightly

abbreviated, and its price in paper covers is 6*d*., or in cloth, with Dr. Bastian's portrait as frontispiece, 1*s*. net.

A CATALOGUE of rare and valuable books and autograph documents and letters has been issued by Mr. Bernard Quaritch, of Grafton Street, London, W. The catalogue runs to 336 pages, and contains full sections dealing with works on astronomy, mathematics and physics, topography, and other subjects likely to appeal to scientific readers.

A SEVENTH edition of "A Treatise on Ore and Stone Mining," by Sir Clement Le Neve Foster, F.R.S., has been published by Messrs. Charles Griffin and Co., Ltd. The work appeared first in 1894, when it was reviewed at length in NATURE (vol. l., p. 543) by the late Mr. Bennett H. Brough, who was afterwards responsible for the sixth edition, issued in 1905, and reviewed in NATURE of January 4, 1906 (vol. lxxiii., p. 220). The present issue has been revised by Prof. S. Herbert Cox, who has adhered to the original general scheme of the book. The price of the treatise is 28*s*. net.

THE issue of the *British Journal of Photography* for March 18 is the third of the special "colonial" numbers, in which that journal addresses itself specially to photographers and photographic dealers abroad. The enlarged text pages contain contributions on studio matters, including the first of a series of articles for the young professional portraitist on securing different effects of lighting. Mr. Edgar Clifton writes on the care of lenses in the tropics, Mr. Welborne Piper on the adjustments of the enlarging lantern, whilst a large proportion of the letterpress deals with recent introductions by photographic manufacturers.

OUR ASTRONOMICAL COLUMN.

THE SOLAR ECLIPSE OF 1912 APRIL 17.—In an article published in the *Revue générale des Sciences* for February 15, M. D. Savitch discusses at full length the circumstances of the solar eclipse of 1912 April 17.

The central line passes through Portugal, the Bay of Biscay, and across France to Belgium, its direction being north-east. It passes within ten miles of Paris. Only about three times a century is an eclipse total in France.

The magnitude of the eclipse along its central line is continually diminishing, and the character of the eclipse changes from total to annular. The point, however, where this change takes place can hardly be assigned with certainty, for it is largely displaced by a small change in the adopted semi-diameter of the moon; the difference of 1·18″ between the values used by the Nautical Almanac and the Connaissance des Temps is sufficient to displace it by some hundred miles from a position out at sea to the neighbourhood of Paris.

In any case, totality is too short for the eclipse to be of much value in the usual way. Nor is there much reason to expect better results than usual from observations to determine the moon's position. No eclipse since 1715 plays a prominent part in determining the position of the moon, and the eclipse of 1715 and its predecessors are important because they are ancient rather than because they were accurately observed in the modern sense of the word accurate.

M. Savitch's article is clear, and illustrated by an excellent map.

THE COMETS (1910*a* AND HALLEY'S).—A large number of observations of comet 1910*a* are published in No. 4392 of the *Astronomische Nachrichten*, including those made at Kodaikanal, Cambridge, Helwan, and Greenwich. Mr. Michie Smith reports a number of positions, several of which, it is interesting to note, are referred to positions of a sun-spot. On January 31 Mr. Evershed traced the tail to a distance of 27° from the head.

Herr Konkoly reports the presence of the three hydrocarbon bands, in the spectrum of the comet, on January 26, and states that the continuous spectrum was faint, whilst a fourth band was suspected.

Dr. Kobold has carried his ephemeris back to the beginning of November, and shows that, although the comet was probably brighter than the sixth magnitude as early as December 1, it was apparently so near the sun as to render its discovery improbable. The ephemeris published in No. 4393 of the *Astronomische Nachrichten* indicates that the comet may become observable again about the first week in April as a morning star, but it will be faint and difficult. A note in the *Observatory* for March emphasises the necessity for such observations being made, if possible, because of their value in determining more rigidly the exact form of the orbit.

Dr. F. J. Allen kindly sends us a beautiful drawing of the comet depicting its form as he saw it on January 30 from the Mendip Hills; the observations were recorded in our article of February 10 (NATURE, No. 2102, p. 441). He directs especial attention to the pronounced curve of the tail towards its extremity, the direction beyond α Pegasi, the uppermost star shown, being nearly horizontal, and states that the comet as here shown is, relatively to the stars, too bright, while the head is perhaps a little too large; but the form and extent of the tail are as he saw it.

Comet 1910*a*. From a drawing by Dr. F. J. Allen.

Dr. Allen, referring to the passage of the earth through the tail of Halley's comet on May 18, suggests that a well organised attempt should be made to collect some of the cometary dust which may then enter our atmosphere. It will be remembered that Prof. Turner, in his recent Royal Institution lecture, suggested that some such attempt should be made, by "bottling" some large quantities of the atmosphere. It is obvious that to have any hope of success the "bottling" would have to be done on a very large scale and under the most favourable and rigid conditions. Dr. Allen suggests a large chamber, carefully prepared and situated in a position where the air is usually very free from contamination, through which immense quantities of the atmosphere could be drawn and filtered. The filtering should be carried on before, during, and after May 18, in order that differential tests might be applied to determine the extra-terrestrial origin of the collected dust. As the cometary dust, and gas, may take days, or weeks, to diffuse sufficiently to reach the earth's surface, the experiment should be continued for some time after the critical date, thus affording opportunity to detect any differences in the collected matter.

In No. 5 of the *Revue générale des Sciences* (March 15, p. 177) M. G. Renaudot makes the interesting suggestion that the periodicity of comets, or of Halley's comet especially, was known and recognised by the ancient Hebrews. He bases this suggestion on a passage in the Talmud, where one of two voyagers explains that he has laid in a stock of flour, rather than bread, because "*There is a very bright star which appears every seventy years* and which deceives navigators. Thinking that she may surprise us during this voyage, and so prolong our journey, I have provided the flour." M. Renaudot gives reasons why the expected object should be considered as a comet, rather than as a long-period variable, for instance, explains that 70 instead of 75 is in accordance with the habit of giving round numbers, and states that the existence of the two important personages between whom the dialogue took place is well attested historically.

A second edition of Prof. Turner's British Association address on "Halley's Comet" has just been issued by the Clarendon Press at the price of 1*s.* net.

EPHEMERIS FOR EROS, 1910.—To facilitate observations of Eros during the coming opposition, Prof. Wendell has computed an ephemeris, which is published in Circular No. 153 of the Harvard College Observatory. Unfortunately, the planet will not be observable in these latitudes, its declination at opposition (May 23) being 46° 31′ S., but, as its orbit and light-variations are so peculiar, it is hoped that a number of observations will be secured at southern observatories.

PROF. DOBERCK'S DOUBLE-STAR OBSERVATIONS.—In continuation of a list which appeared in Nos. 4327–8 of the *Astronomische Nachrichten*, Prof. W. Doberck now publishes his observations of a great number of doubles, at Sutton during 1909, in Nos. 4394–5 of the same journal. Each observation is recorded separately, and the position-angle and distance of each pair are given for the mean epoch of observation.

DANIEL'S COMET, 1909*e*.—A photograph of Daniel's comet (1909*e*) was secured by Dr. Wolf on February 28, when the comet's magnitude was 15·0. It now appears that this comet belongs to the Jupiter, and not to the Uranus, family of comets, as was at first suspected.

THE NATIONAL PHYSICAL LABORATORY IN 1909.

THE general board of the National Physical Laboratory held their annual meeting at the laboratory on Friday last, March 18, when the report of the work done during 1909 was presented, and the programme of work proposed for the year 1910 was approved. The chair was taken by Sir Archibald Geikie, as president of the Royal Society, and Lord Rayleigh, chairman of the executive committee, was also present. A large number of guests were invited to inspect the various departments of the laboratory.

Two new branches of the work claim attention this year. The first of these is the national experimental tank for experiments on ship models, which is being constructed at a cost of about 20,000*l.*, provided by the generosity of Mr. A. F. Yarrow. A maintenance fund for carrying on the work of the tank for the first ten years has also been provided with the aid of the Institution of Naval Architects. With regard to the details of the working of the tank, assistance will be given, under a scheme printed in the laboratory report, by an advisory committee composed of members nominated by the Institution of Naval Architects and by the executive committee of the laboratory.

The tank itself, and the office buildings and workshops required, are now nearly completed. The length of the tank is 500 feet at the full depth of 12½ feet, and the width 30 feet. At the north end are docks for receiving the models, while at the south end is a shallow "beach" for breaking the waves. As was shown by Dr. Glazebrook in a report presented in March, 1909, to the Institution of Naval Architects, models up to 20 feet in length and 3 feet in breadth can be tested in a tank of the width stated without any appreciable effect on the results due to the sides.

The models will be towed along by a carriage, electrically driven, spanning the tank and running on rails on either side. This carriage carries the observers and dynamometers. The models will usually be made of paraffin wax, and the equipment will include special model-cutting machinery. None of this apparatus, however, is yet installed, and we hope, at a later date, to give a more detailed account of the tank and of the special apparatus employed.

The second large development of the work during 1909 is the formation of a division for research in aëronautics. This work has been undertaken in accordance with the announcement made by the Prime Minister in the House of Commons on May 5, 1909, and is under the general superintendence of the Advisory Committee for Aëronautics then appointed. Rapid progress has been made during the year with the provision of the necessary equipment for the experimental work at present planned. This includes an air channel 4 feet square in section by 20 feet long for general work in aërodynamics, a whirling table 60 feet in diameter for propeller testing, in a special building 80 feet square; dynamometers for motor testing, with arrangements for an air blast for air cooling; and two wind towers for work on a large scale in the open. All this apparatus has been erected, and experiments have been for some time in progress. The division is under the charge of Dr. Stanton as superintendent of the engineering department, and his great experience on the subject of wind pressure will be especially valuable. To provide the increased accommodation necessary, two more bays have been added to the engineering building.

The testing of balloon fabrics also constitutes an important branch of the work. Tensile and bursting tests have been carried out in the engineering department, while in the chemical department a special apparatus has been devised for the determination of the permeability to hydrogen. We may, perhaps, be able on another occasion to give further particulars of the aëronautical equipment.

Turning now to the physics department, in the electrical standards division good progress has been made with the erection of the Lorenz apparatus for the determination of the ohm in absolute measure, and this is now nearly complete. The coils, wound on marble cylinders, have been made in the laboratory; the main part of the machine, by the kindness of Sir Andrew Noble, has been constructed at Elswick. The determinations to be made with this will be the chief work in this division during the current year. With regard to standard cells, a research has been in progress to determine the limits of temperature between which cadmium amalgams of various concentration can be usefully employed, the results of which were communicated to the Physical Society by Mr. F. E. Smith in a recent paper. The general conclusion arrived at is that an amalgam containing 12½ per cent. of cadmium cannot safely be used below 12° C., and the substitution of a 10 per cent. amalgam is recommended. This can be relied upon to give constant results at a definite temperature for all temperatures between 0° and 51° C.

We have previously made reference to the new order in council lately issued relative to the electrical units, the outcome of the work of the International Conference in London in 1908. To complete the work of the conference, representatives from the chief standardising laboratories are to meet at Washington shortly to continue jointly the researches necessary to decide on a definite value for the E.M.F. of the Weston cell.

Another matter in which international cooperation is being arranged is the question of the methods of measuring hysteresis and eddy loss in steel sheet. A modification of the Epstein method has recently been devised by the Bureau of Standards which appears to give accurate results, and investigations relative to this question have been in progress at the laboratory.

In the electrotechnics division much attention has been given to perfecting the equipment for alternating-current measurements. Features of special interest are the non-inductive water-cooled tube resistances, described in a paper communicated to the Institution of Electrical Engineers, and the quadrant electrometer for use as an alternating-current wattmeter. The 100,000-volt transformer equipment has been completed, and has been employed in an investigation into the properties of different varieties of ebonite, while a research on insulating materials is in progress. In the photometry section a considerable

amount of work has been done towards setting up sub-standards for use in measurements of metallic filament lamps. The determination of the candle-power of these in terms of the pentane standard involves a comparison between lights of different colour, and in the process of stepping up as many observers as possible must be employed to obtain a representative mean.

Early in the past year an agreement was arrived at between the authorities in America, France, and this country as to a common light unit, the American unit being altered by 1·6 per cent. to bring it into agreement with the British unit expressed in terms of the 10-candle Harcourt pentane lamp.

In the thermometry division the work has consisted in great measure of improvements in the equipment, especially with the view of the extension of the work on the fundamental gas scale to higher temperatures. It is hoped that a useful material for gas-tight vessels has been obtained, but further progress required power for heating larger furnaces, which has now been provided.

In the metrology division an interesting experiment is being tried in the use of silica as a material for standards of length. The advantages are a low coefficient of expansion and small thermal hysteresis, *i.e.* the temporary change in length due to a cycle of temperature change is small. A standard has been constructed with flat and parallel end slabs fused into a hollow cylindrical rod, the slabs being platinised to receive the divisions. The study of this standard will be continued during the present year.

Important additions have been made to the sets of standard screw gauges in the possession of the laboratory. These now comprise complete series of British standard Whitworth threads, British standard fine threads, British standard electrical conduit gauges, and B.A. threads. They have been constructed by Armstrong, Whitworth and Co. to the dimensions laid down by the Engineering Standards Committee. Two large machines for pitch and diameter measurements are also being constructed at Openshaw.

The 50-metre mural base for verification of surveying tapes has been completed. The length of this base is stepped out against a 4-metre standard bar, itself determined against the standard metre. Another important piece of work has been the re-erection of the Blythswood ruling machine for ruling diffraction gratings. By shifting the periodic error connecting cam from one end of the screw to the other, the length of grating which can be ruled has been increased from 5 to 8 inches. The exact setting of the periodic error cam alone remains to be done to enable the ruling of gratings to be commenced.

A useful piece of work in the optics division has been the devising of a new apparatus for testing photographic shutters. The method is essentially that of Sir Wm. Abney, with the use of a vibration galvanometer in place of a siren as a time recorder.

In the engineering department a large number of researches are in progress. Dr. Stanton is continuing his wind-pressure work, as well as the research on the resistance of materials to alternating stresses of high frequency. Some very interesting results have been obtained with regard to the heat transmission and friction of air currents in pipes, and a paper on the resistance of plates and models in a uniform current of water was communicated to the Institution of Naval Architects. The water channel used for these experiments has been utilised also for work in connection with aëronautics, and gives results closely comparable with those obtained in an air channel, allowance, of course, being made for the difference in density. A valuable paper by Mr. Bairstow on the elastic limits of material under alternating stress has been published in the Philosophical Transactions, and contains interesting experimental conclusions relative to the theory of fatigue. Another research of importance which is in progress relates to the strength and efficiency of welded joints, from which the preliminary conclusions have been reached that the material at a welded joint is often in a dangerously brittle state, and that a long weld is essential to secure even moderately good results.

In the department of metallurgy and metallurgical chemistry, the work done for the Alloys Research Committee of the Institution of Mechanical Engineers was embodied in the ninth report, on some alloys of copper, aluminium, and manganese, presented to the institution early in 1909. Further work on the light alloys of aluminium is in progress. The eutectics research, on which a first communication appeared in 1908 in the Philosophical Transactions, has been continued, attention being especially directed to the mode of solidification of eutectic alloys. A preliminary account of an investigation into the effects of strain at high temperatures, recently published in the Proceedings of the Royal Society, presents features of interest. It was established that deformation by intra-crystalline slip occurs at temperatures up to 1100° C., while the three allotropic modifications of iron known as α, β, and γ iron showed marked differences in the effects of strain. A number of cases of failure in practice have been investigated, and in connection with these a systematic study is being made of the modes of fracture of steel.

The work of the observatory departments of the laboratory, at Kew and Eskdalemuir, is of a distinct character, and need not be referred to now in detail. Mention must, however, be made of the admirable piece of work completed by Dr. Chree, in the discussion of the magnetic curves of the National Antarctic Expedition of 1902–4, printed in the volume of "Magnetic Observations" issued by the Royal Society early last year.

INSTITUTION OF NAVAL ARCHITECTS.

THE spring meetings of the Institution of Naval Architects commenced on Wednesday, March 16, in the rooms of the Royal Society of Arts. The institution has now completed its first fifty years of existence, and proposes to celebrate its jubilee by special meetings commencing on July 4. The council also recommended that the present time is favourable for applying for incorporation under a Royal charter, an opinion which was endorsed by the members at the Thursday meeting. A presidential address was delivered by Earl Cawdor, and premiums were awarded to Dr. T. E. Stanton and Mr. H. C. Anstey for papers, respectively, on the resistance of thin plates and models in a current of water, and on the application of internal-combustion engines for marine propulsion. Thirteen papers in all were presented at the meetings, abstracts from some of which we give below.

A systematic series of experiments on wake and thrust deduction has been carried out recently at the experimental tank of Messrs. John Brown and Company's establishment at Clydebank, and form the subject of a paper contributed by Mr. W. J. Luke. Experiments were made with twin and with single screws, and in all cases where twin screws were run the experiments were made in both directions of rotation. The work involved the carrying out of at least 2000 experiments. The effective horse-power may be expressed as the product of the thrust horse-power and the hull efficiency, the latter quantity being the product $(1+w)(1-t)$, where w is the wake fraction and t is the fraction of the total thrust by which the tow-rope resistance is less than the thrust exerted by the screw when propelling the ship. The experiments were directed towards determining the variations in w and t when (*a*) speed, (*b*) diameter, and (*c*) pitch ratio were varied. With naked models a decrease in wake fraction is evident with an increase of speed; changes which appeared for variations in diameter might be as much owing to alterations in clearance; variation in pitch had little or no effect on either of the hull-efficiency elements.

Prof. B. Hopkinson, in his paper on the measurement of shaft horse-power by torsion-meters, directed attention to the need for further experimental work on full-sized shafts with the view of ascertaining whether twist may be produced by means of a longitudinal push or pull. Such would imply, if no torque be applied, a peculiar structure of the shaft, which might be described as a helical arrangement of the fibres. Mr. C. E. Stromeyer gave results of his observations of the brittleness of mild steel due to nitrogen. It has not yet been possible to combine nitrogen with steel by merely heating the two together, but this may be effected by heating steel in an atmosphere of ammonia. Ammonia may be present in blast furnaces if

the coking of the fuel has not entirely removed the nitrogen which was present in the coal. It also seems that, when nitrogen has once entered pig-iron in the blast-furnace, it cannot be removed by subsequent heating. It seems desirable to ascertain more definitely by further experiments how titanium acts in practice in the removal of nitrogen from steel.

A very important paper was presented by the Hon. C. A. Parsons on the application of the marine steam turbine and mechanical gearing to merchant ships. The steam turbine has not hitherto been applied to vessels of slow normal speed on account of the high initial cost and inferior economy in steam. No promising scheme has, as yet, been evolved whereby the efficient speed of the turbine may be reduced and that of the propeller increased for vessels of 12 knots sea speed and under. The only approach of meeting these conditions has been in the combination system of reciprocating engines and turbines, in which the lower stages of the expansion are effected in the turbines.

Provided the losses in transmission, first cost, and cost of maintenance are not too great, the most satisfactory solution for slow-speed vessels would appear to be by means of gearing. Mechanical, electrical, and hydraulic gearing have been proposed or applied, and the author proceeded to give an account of his successful experiments in developing a mechanical gearing.

Helical and double helical gear wheels of fine pitch were probably first introduced by De Laval in connection with his turbine, and have proved to be very satisfactory and efficient. Mr. Parsons has had several sets made. One of these, made in 1897, gearing from 9600 revolutions of the turbine to 4800 of the dynamo, transmitted 300 horse-power with an efficiency of more than 98 per cent. This gear ran fourteen hours a day for about a year. Recent and better cut gears have given a total loss in the gear-case of 1·5 per cent., including friction of gear and bearings.

The author was thus led to experiment with a view to obtain comparative figures for a cargo vessel, first fitted with ordinary reciprocating engines, and then with turbines and mechanical gearing of the above-mentioned type. The *Vespasian* was purchased for this purpose. Her dimensions are:—length on load water-line, 275 feet; breadth moulded, 38 feet 9 inches; depth moulded, 21 feet 2 inches; mean loaded draught, 19 feet 8 inches; displacement, 4350 tons. The vessel was first fitted with triple-expansion surface-condensing engines of ordinary pattern, cylinders $22\frac{1}{2}$ inches by 35 inches by 59 inches, and 42-inch stroke. There were two boilers, each 13 feet in diameter and 10 feet 6 inches long, of total heating surface 3430 square feet, and grate area of 98 square feet. The working pressure was 150 lb. per square inch. A four-bladed cast-iron propeller was fitted, having a diameter of 14 feet, pitch 16·35 feet, and expanded area of 70 square feet.

Before proceeding on the experimental voyage from the Tyne to Malta, the reciprocating propelling machinery was completely dismantled and overhauled. The machinery was thus brought into an efficient and first-class working order. Suitable tanks were provided for measuring the steam consumption. Loaded with a cargo of coal, the *Vespasian* left the Tyne on June 26, 1909, and careful measurements of coal and water consumption were made throughout the voyage by a special recording staff.

On the completion of this voyage the vessel returned to the turbine works, the reciprocating engines were removed, and turbines and gearing fitted. The importance of these trials lies in the fact that the only alteration made in the vessel was in the type of propelling engines. Boilers, propeller, shafting, and thrust blocks remained the same as for the reciprocating engine.

The turbine machinery consisted of two turbines in series, one high-pressure and one low-pressure, the high-pressure turbine being on the starboard side of the vessel and the low-pressure on the port side. At the after end of each turbine a driving pinion is connected, having a flexible coupling between the pinion shaft and the turbine, the pinion on each side of the vessel being geared into a wheel which is coupled to the propeller shaft. A reversing turbine is incorporated in the exhaust casing of the low-pressure turbine. The usual air, circulating, feed, and bilge pumps are driven from the forward end of the gear-wheel shaft. The turbine and pinion shaft bearings are under forced lubrication; the teeth of the gear wheels are lubricated by means of a spray pipe extending over the whole width of the wheel face.

The high-pressure turbine is 3 feet maximum diameter by 13 feet over-all length, and the low-pressure 3 feet 10 inches in diameter by 12 feet 6 inches in length. The turbines were balanced for steam thrust only, the propeller thrust being taken up by a thrust block. A new condenser with a vacuum augmentor was fitted. The gear wheel is cast iron with two forged steel rims shrunk on. This wheel is 8 feet $3\frac{1}{2}$ inches in diameter of pitch circle, and has 398 double helical teeth of circular pitch 0·7854 inch. The total width of face of wheel is 24 inches; the teeth have an inclination of 20° to the axis. The pinion shafts are of chrome nickel steel, 5 inches diameter of pitch circle, with twenty teeth of 0·7854 circular pitch. The ratio of the gear is 19·9 to 1.

On completion of the alterations, at the end of February of this year, the vessel was loaded to the same draught and displacement as that recorded for progressive trials on the Hartley mile with reciprocating engines. In the short interval since the completion of the alterations the vessel has been out to sea on four occasions.

Mr. Parsons gives full information and curves showing the results of the trials. We abstract the following important figures from these.

Water Consumption per Hour, for all Purposes.

Revolutions of propeller	Speed of vessel, knots	Lbs. of water per hour: Reciprocating engines	Lbs. of water per hour: Turbines	Saving, per cent.
60	8·87	11,750	10,750	8·5
65	9·55	14,500	12,600	13
70	10·2	17,500	14,750	16

The turbines and gearing have given no trouble, and have worked satisfactorily, with very little noise or vibration, throughout the trials. There is no appreciable wear on the teeth or bearings. It is proposed to put the vessel into commission and run extended trials. Mr. Parsons further added that the saving in weight on installing the turbines amounted to 25 per cent.

Speakers in the discussion were unanimous in commending Mr. Parsons for his success, which is likely to revolutionise the means of propulsion of tramp steamers, which, as Sir William White remarked, form the backbone of mercantile business. Prof. Ewing pointed out the greater simplicity of mechanical gear as compared with electrical, and also directed attention to its much higher efficiency. He thought it most appropriate that the solution of this important problem should have fallen to the lot of the inventor of the steam turbine. The economy of Mr. Parsons's new system could be simply expressed as the saving of one boiler in six required for ordinary reciprocating engines.

AN INSTRUCTIVE EARTH MODEL.

AT the Hotel Cecil on March 17 Mr. G. R. Gill showed a large model of the earth which, while large enough to admit of the representation of surface features in detail, can be packed into a comparatively small cabinet. A rectangular box 5 feet by 3 feet by $1\frac{1}{2}$ feet is wheeled easily into position, the folding lid is opened, a quadripod arrangement is raised and made rigid, a steel axis with aluminium ends is slipped into position, eighteen meridians are fitted into the ends and stay in place by their own elasticity, the three parts which go to form the equator are placed by the side of the box, and this gives the arrangement of the skeleton globe which is shown in Fig. 1.

The slope of the axis is adjustable to any angle, that of $23\frac{1}{2}°$ being noted by a bell signal. The globe can be made to rotate by hand or by electric motor. The diameter of the globe is 4 feet $2\frac{1}{4}$ inches, which gives a scale of $1/10^6$. The meridians are made of twelve thicknesses of very thin wood cemented and rivetted together.

The equator is then fixed, and from a cupboard thirty-six sections are taken and fitted into place. Fig. 2 shows the operation of inserting the last section, and shows, approximately, the height of the erected globe. The sections are of mild steel faced with *papier-mâché*, and are

sufficiently strong to resist fairly rough treatment. The surface shown in Fig. 2 is that of the earth in relief, where the scale is $1/5 \cdot 10^5$, giving an exaggeration of twenty times. This surface shows the relief of the land, the depressions of lakes and rivers, while the limits of pack- and drift-ice in the Polar regions are ingeniously marked. From the scientific point of view it is perhaps a pity that the relief of the ocean beds has not been shown, as one of the important advantages of a globe on this scale appears to be the possibility of an adequate realisation of the gradients of the land surface, and such a conception loses more than half its value when it is limited to the subaërial parts; possibly the inventor, Mr. G. R. Gill, will be able to make sections to show the complete relief of the solid crust.

Other surface sections are available; first, political sections showing by divers colours the great world empires, the railways, the rivers, and the ocean and cable routes;

FIG. 1.—Meridians in place.

secondly, plain sections on which the demonstrator may draw his own sketches. These sections are interchangeable, so that pupils may be tested as to their power to draw coast lines, &c. The whole globe can be set up in a few minutes, and a few seconds suffice for the changing of sections. Additional attachments are provided so that the large globe may be used to represent the sun, and a set of small balls, mounted at varying slopes, the planets; the Pole Star and Ursa Major are represented by a set of small balls to be fixed to the axis. There appears to be no difficulty in arranging the surface sections so that the upper half represents the southern hemisphere.

For purposes of measurement, and for the elucidation of "great circle sailing," schoolmasters will probably ask Mr. Gill to supply a thin steel band, graduated in degrees, which could be used to demonstrate and measure the shortest distance between two places upon the earth.

The model is sufficiently large and rigid that a youth may climb into and hide within the interior, and it is probable that for teaching purposes the possession of this globe would render the use of wall maps of the continents unnecessary for class work in geography. The teacher of geography by the methods of modern science will find this globe extremely useful, not only as his final resort in summarising the pupils' studies of a definite region, but in putting that region in precise relationship with the neighbouring regions; in our opinion there seems to be no end to the many practical exercises of a "heuristic" nature which pupils could be set, even to the extent of several at a time working on the one globe.

Many little devices suggest themselves at once whereby the main factors of the earth's climatic conditions might become more real; it will suffice to suggest one use of a slightly different nature; the room is darkened, the rays from the lantern are centred accurately on the model, questions of local time and sun time are discussed, and with a needle to represent a stick the shadow exercises so common in school work in the playground are repeated on the globe, with this advantage, that the graph obtained to show the sun's altitude, which took the whole of one school year to make, may now be made in a shorter period, when the work may be carried through without a break. The inventor may be congratulated on the way in which he has surmounted many mechanical difficulties, and in

FIG. 2.—Inserting the last section.

which he has produced an important addition to the apparatus which may be used to teach geography scientifically.

B. C. W.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING.

THE fourth annual report of the president and treasurer of the Carnegie Foundation for the Advancement of Teaching is now available, and deals with the work of the year ending September 30, 1909. It will be remembered that, in dealing with the third report in our issue of June 3, 1909 (vol. lxxx., p. 399), Prof. J. Edgar described at length the scope and character of the foundation, and it is necessary here to deal only with points of interest in the work of the past year.

During the year the foundation granted 115 pensions amounting to 35,400*l*. It is now paying 318 pensions, the cost being 93,200*l*. The professors receiving these pensions are from 139 colleges, distributed over forty-three States of the Union and provinces of Canada. To the accepted list of colleges, that is, to the list the professors of which may regularly receive pensions under fixed rules as a right and not as a favour, seven colleges were admitted during the year. The governors and legislatures of twenty-six

other States asked that their universities should also be admitted to the foundation. The fact that only five State institutions, one of these in Canada, have been admitted to the Carnegie Foundation, after a year of administration of the rules under which tax-supported colleges and universities became eligible, testifies to the scrutiny exercised in the admission of institutions. There are now sixty-seven institutions on the accepted list.

The second section of the report is devoted to an examination of the working of the rules for retirement, as shown in the experience of the past four years. As a result of the experience, two changes were made in the rules by the trustees; one extends the benefits of the retiring allowance system so that service as an instructor shall count toward the earning of a retiring allowance. Heretofore only service in the rank of professor was counted toward an allowance. The other change makes retirement after twenty-five years of service possible only in the case of disability unfitting the teacher for active service. Except in the case of such disability, the teacher can, under the rules as now framed, claim a retiring allowance only upon attaining the age of sixty-five. Formerly a professor might retire after twenty-five years of service. This change in the rules does not, however, deprive the widow of a teacher who has had twenty-five years of service of her pension.

The third section of the report is devoted to tax-supported institutions. Agricultural education and the agricultural college are also treated at length. The trustees make clear their intention to ask of the institutions of every State whether the university and the college of agriculture are competing or cooperating parts of a State system of education. The low standards and general demoralisation resulting from the competition of these two types of tax-supported institutions in the various States are pointed out. In the fourth section of the report it is said to be noteworthy that only a small proportion of the colleges and universities calling on the public for support print a straightforward financial statement showing what they do with the money collected from the public. Following the report of the president is the report of the treasurer. In this matter the foundation has followed the advice which it gives to other institutions, and prints a detailed statement, showing, not only the larger items of expense, but even the individual salaries which are paid.

BOSTON MEETING OF THE AMERICAN ASSOCIATION.

EXTRACTS FROM THE ADDRESSES OF SECTIONAL PRESIDENTS.

The Teaching of Physics.

IN his address to Section B (Physics), Prof. K. E. Guthe discussed reforms needed in the teaching of physics. He maintained that the decision as to how physics should be taught rests finally with those men who know the subject, understand the spirit of the science, and for this reason are the only judges of its characteristic educational value. Concerning himself particularly with the teaching of physics in American colleges and universities, he proposed two questions, "May not the preparation which professors give future teachers be faulty?" and "May not the professors' teaching be capable of improvement?" He said he believed both these questions should be answered in the affirmative. The system of the teaching of physics in many American colleges and universities is, he maintained, more adapted to train professional physicists than future high-school teachers. The two should receive a different training. The ideal high-school teacher is one who has passed through a complete and thorough graduate course. At the present time the great majority of American high-school teachers do not go beyond graduation, and Prof. Guthe would deplore any attempt to crowd so much physics into the undergraduate course that the physicist finally turned out lacks the general culture which an undergraduate course should give. American professors of physics should, he insisted, emphasise more problem work in connection with the elementary course. An utter helplessness of many higher classmen in attacking elementary problems is not unusual. The laboratory work given with the elementary course is frequently quite insufficient, and a somewhat advanced course, not in special lines, but covering the whole field, will do an untold amount of good. Finally, there should be a general review of the whole subject from a higher point of view than is possible in the elementary course. The calculus might be a required study for this. At this point subjects might be taken up which have been omitted in the first course; the treatment could be more thorough and more exact. The introduction of such an advanced course would also have a good influence upon the first course. Prof. Guthe advised future teachers of physics to take also a course in meteorology, a short course in dynamo-electric machinery, and an elementary course in instrument-making, all of which might properly be given in the physics department. Such a graded course will produce, he thinks, teachers to whom may be left without hesitancy the question as to how physics should be taught in the high school. The second proposition considered was, "Professors of physics are far from being unanimous in the use of certain terms, and frequently employ the same term to designate two entirely different physical quantities." This means that enough attention is not paid to the very things which make physics so valuable as a training of the mind, namely, clearness of thinking and accuracy of expression. Prof. Guthe cited and considered numerous cases in point, among them being the terms used in connection with pressure, surface tension, measurement of quantities of heat, and fields of magnetic force.

The Study of Solutions.

Prof. Louis Kahlenberg, of the University of Wisconsin, presided over Section C (Chemistry), and in his address dealt with the past and future of the study of solutions.

The study of solutions, he said, was begun with the chemical conception of solutions, and upon this conception many relationships were worked out during the first eighty-seven years of the nineteenth century. The older chemists clearly recognised that whether solution will take place or not in a given case is first of all determined by the chemical nature of the substances brought into contact with each other. They saw that the temperature factor was next in importance, and that pressure was of vital consequence when a gas was under consideration, but of slight importance in the case of solids and liquids. When the conception that solutions are mere physical mixtures came to the foreground, through the introduction of gas analogies and the intense propagandism of the dilute school, the fact that the act of solution is really chemical in character was lost sight of by many able, enthusiastic young investigators. In the ardour of their quest they were misled, and unwittingly they naturally misled others. It is really pitiable to see how physiologists, having thus taken up these misconceptions of the nature of solutions, are still wasting precious time in endeavouring to work out the complicated and very important processes that occur in living plants and animals. In these problems, which are in reality perhaps the very greatest that confront us at the present day, theories of solutions based on gas analogies are of no avail. They are thoroughly misleading and worse than worthless here.

The clear recognition that solutions are really chemical in character, and that there is no wide gulf that separates the act of solution from other chemical phenomena, will do much toward furthering the future study of the subject. Years of experimental study of the chemical, physical, and physiological properties of a long list of both aqueous and non-aqueous solutions have led to the conviction that the act of solution is chemical, that solutions are chemical combinations, and that we can only make real progress toward a better understanding of the various solutions by recognising this as the basis of all our future work. The efforts to gain a better insight into the different solutions that confront us must be chiefly experimental, rather than mathematical; for in the study of solutions, just as in the study of chemical compounds in the narrower sense of the word, we are continually confronted with discontinuities. Now discontinuous functions cannot be handled mathematically at present, not even by the greatest of our mathematicians, for though work of this kind has been begun, it is still in a very rudimentary stage. It is highly probable, too, that the renewed study of solutions

from the chemical point of view will greatly aid us in getting a broader and more correct conception of the nature of chemical action itself. Certainly in living beings we have numerous, fundamental, and deep-seated chemical changes going on continually with apparently the greatest ease at ordinary temperatures and pressures, and it is tantalising that we are unable to comprehend how this is all brought about. In the unravelling of the questions that here confront us a clear recognition that solutions are chemical in nature will be of the greatest service.

Engineering as a Profession.

Prof. G. F. Swain, of Harvard University, addressed Section D (Mechanical Science and Engineering) on engineering as a profession. During the course of his remarks he said:—

The field of engineering is more extensive than that of any of the three so-called learned professions, and the different branches of the profession differ from each other to such an extent as in some cases to have little in common, except a knowledge of the general principles of physics, chemistry, mechanics, and other sciences. The profession of the physician, it is true, is divided into many specialities, but while the throat specialist deals with the throat, and the stomach specialist with the stomach, they are all dealing with the human body, in which all the parts and functions are closely interconnected; but even within the field of what is termed civil engineering, the railroad engineer and the irrigation engineer, or the railroad engineer and the architectural engineer, have little in common.

The work of the engineer as applied to any contemplated project consists essentially of four parts, first, to ascertain whether anything should be done, and, if so, what should be done; second, to design and formulate the means to be employed in doing it; third, to select the proper materials; and, fourth, to carry on the actual work into execution. As the engineer's problem is to adapt the materials, the forces, the sources of power in nature to the use and convenience of man, it is clear that in order to fulfil his calling to the highest extent the engineer should be scientifically trained—that he should be familiar with the fundamental principles which govern natural phenomena. Different branches of science are required in varying degrees in the different branches of the profession, but every engineer should know, and know thoroughly, the fundamental principles of chemistry, physics, mathematics, and mechanics. The engineer should be possessed of the true scientific spirit, loving the study of science for its own sake as well as for its applications, and trained to seek always the truth, the whole truth, and nothing but the truth; but the work of the engineer deals, not with science for its own sake, but with its applications to the practical affairs of men. The engineer must, therefore, be above all a *practical man*. He must not be a pure theorist, a dreamer, a visionary. He must see in his mathematical formulæ a meaning, and not a simple accumulation of letters. The engineer, then, must not only be a scientific man, but he must be, first and foremost, a practical man; and, on the whole, the latter is more important than the former, although it is in the proper combination of the two that the greatest excellence will result.

The engineer, unlike the true man of science or mathematician, does not work in his laboratory or his study—his work is with the affairs of men. Engineering is more than half business, and the successful engineer, therefore, must be to a considerable extent a *business man* and a *financier*.

The profession of the engineer is a wide and varied one, but it requires varied qualifications, and demands pre-eminently an all-round man. It must not be forgotten, however, that without the scientific training, or at least the scientific spirit, the engineer will not attain the highest success. It is also evident that the thoroughly trained and capable engineer will find many opportunities to make himself useful in scientific as well as in administrative positions. He will also find many opportunities for doing general public service to the State or nation. Different men have different ideals of success, but the highest ideal is the one which most involves the idea of public service.

The Principles of Palaeogeography.

In his presidential address to Section E (Geology and Geography), Prof. Bailey Willis, of the University of Chicago, discussed the principles of palæogeography. To summarise his remarks, it may be said that the following were given as the fundamental principles of the science:—

Ocean basins are permanent hollows of the earth's surface, and have occupied their present sites since an early date in the development of geographical features. This principle does not exclude notable changes in the positions of their margins, which have encroached upon continental areas.

Superficial oceanic circulation within the permanent oceans has persisted since an early stage of their existence, essentially in the great drifts which it now follows under the trade winds. It is probable that the present deep circulation of oceanic waters, poleward at the surface and equatorward below the surface, is due to exceptional refrigeration at the pole.

Diastrophism has been periodic. Viewed according to the periodicity of diastrophism, the earth's history falls into cycles, and each cycle into two periods, one of inactivity and another of activity. The periods of inactivity have been long, and during a major part of the duration of any such period the condition of inactivity has been common to the entire surface of the globe. The periods of diastrophic activity have been relatively short, and, as regards the whole surface of the earth in general, not contemporaneous. The great ocean basins are distinct dynamic provinces, and each has experienced periods of diastrophic activity peculiar to its individual history. The epochs of organic deformation are relatively brief. Folding and unconformity are frequently not contemporaneous even in one and the same dynamic province.

The processes of erosion, sedimentation, chemical activity, and organic evolution have been periodically conditioned according to the periodicity of diastrophism. The corresponding physical phenomena exhibit rhythmic changes which repeat similar conditions in like associations.

Erosion has been constant on land surfaces through the activity of some of the subprocesses, decay, denudation, or aggradation, which have never failed to make a record.

Marine sedimentation has sometimes been inconstant. During periods of diastrophic activity, when lands have been high, epicontinental seas small, and marine currents largely confined within deep ocean basins, sedimentation has been dominant; but during periods of diastrophic inactivity, when lands have been low, epicontinental seas extensive, and marine currents active on shallows and straits, sedimentation has failed in consequence of non-deposition or marine scour in appropriate situations.

The criteria of correlation are both physical and organic. The physical facts are basal. The organic forms, though endowed with evolutionary energy, are dependent and sequential.

Evolution of Intelligence.

Prof. C. Judson Herrick in his presidential address to Section F (Zoology) discussed the evolution of intelligence and its organs. In the course of his address he observed:—

Many a boy's brains are curdled and squeezed into traditional artificial moulds before he leaves school. His education is complete, and senile sclerosis of the mind has begun by the time he has learned his trade. For how many such disasters our brick-yard methods in the public schools are responsible is a question of lively interest. We who seek to enter into the kingdom of knowledge and to continue to advance therein must not only become as little children, but we must learn to *continue so*. The problem of scientific pedagogy is essentially this—to prolong the plasticity of childhood, or otherwise expressed, to reduce the interval between the first childhood and the second childhood to as small dimensions as possible. The docile or educational period of a mammal is largely devoted to the progressive mechanisation of the in-born plastic tissue of the higher correlation centres, *i.e.* to habit formation or otherwise expressed, to the elaboration of acquired automatisms and reflexes of the type commonly referred to as lapsed intelligence. Much confusion has arisen from the failure to distinguish these individually acquired automatisms from those performed in the hereditary pattern *i.e.* lapsed intelligence from true instinct.

Summarising the argument of his address, Prof. Herrick said:—In our analysis of the behaviour of animals and its mechanisms we start with the tropism and the reflex. This type of response is in some of its simpler phases indistinguishable from the reactions of dead machines to the forces which actuate them; but the more complex reflexes, on the other hand, grade over into those behaviour types which we call intelligent. No one has yet succeeded in formulating a clear-cut definition of the limits of the reflex at either its lower or its higher extreme, and perhaps no one ever will, for the whole list of behaviour types from machines to men probably forms a closely graded series.

Even the simpler reflexes exhibit a measurable refractory phase or pause in the centre where the afferent impulse is made over into the efferent. When reflexes are compounded, there is another factor which may tend to modify or delay the response. This is the dilemma which arises when two or more reflex centres are so related that a given afferent impulse coming to one of them may take any one of several final common paths to the organs of response. The reflex response which actually emerges in such a case will generally be the adaptive one, *i.e.* the one which is best for the organism. The selection of the adaptive response in such a case may be termed *physiological choice*, and it always involves a lengthening of the refractory phase. In the neural tensions of the refractory phase of physiological choice we find the germs of the complex anticipatory reactions which in turn have nurtured the awakening intelligence.

The comparative study of animal behaviour in the broadest sense of the term is as essential as other branches of physiology to the comprehension of animal structures, and the enlargement of our knowledge of scientific fact in this field will contribute greatly to the more perfect integration of the three great branches of biology—anatomy, physiology, and psychology—and the correlation of the whole with other departments of knowledge. Our philosophy of nature is sound just in proportion as we succeed in effecting these correlations of experience.

Response to Chemical Stimulation.

In Section G (Botany) the president, Prof. H. M. Richards, of Columbia University, New York, addressed the members on the nature of response to chemical stimulation. Few, if any, physiologists would, he said, to-day be inclined to deny the ultimate chemical nature of the response of protoplasm to any form of stimulus. It is the purpose here to limit the examination of chemical irritation more especially to actual concrete chemical substances brought into relation with living protoplasm, and to inquire somewhat more particularly into their mode of action and the nature of the changes which they induce. The importance and fundamental nature of these reactions cannot be doubted. For this purpose we may include in the list all those substances which it may reasonably be believed induce, by their chemical action, constitutional changes in protoplasm. These substances may be mineral salts, organic compounds of great diversity of structure, including anæsthetics, which have been, perhaps, wrongly placed in a special class, and even gases of a simple constitution. They may be crystalloidal, electrolytes or non-electrolytes, or perhaps even colloidal.

There are some points in regard to the normal food supply which have a direct bearing upon the question of chemical stimulation, as defined even in its restricted sense. In the case of some of the necessary food materials the concentration may vary within relatively wide limits before the effects of a lack or excess of these substances are observable. In such cases the increase necessary to produce a reaction may readily be so great as to involve a material increment in the isotonic coefficient of the solution, and thus confuse any result produced by any direct chemical stimulus with those initiated by the change in osmotic pressure. It is known, however, that some of the necessary salts which are required by the plant in relatively small quantities may, if the concentration be raised above the normal point, cause a secondary stimulation of growth, and eventually, if the increase be continued, become inhibitory after the manner of poisons.

In its restricted sense, chemical stimulation may be said to deal with the effects of chemical agents which are not only not necessary, but which may be positively deleterious to the organism—poisons, in short. It has been established that many, if not all, classes of substances which exert a toxic action on protoplasm will become stimulatory if presented to the cells in sufficiently small doses. Somewhere between an infinitesimally weak solution which produces no reaction to the toxic dose which kills there is a stimulative optimum which gives the maximum of reaction. The question is not the possible ultimate lethal effect of these poisons, but how far they may serve to excite the protoplasm to extraordinary activity. The amount required to effect the latter result will naturally vary with the substance, certain mild poisons possibly never affecting the plant beyond the stage of stimulating growth, no matter how high a concentration was employed.

Prof. Richards concluded by dealing in some detail with the influence of chemical stimulus on the physiological activities of the plant, and why and in what manner the specific irritants used affect the quantitative, and even perhaps the qualitative, formation of enzymes.

Racial Differences in Mental Traits.

In Section H (Anthropology and Psychology) Prof. R. S. Woodworth, of Columbia University, the president of the section, in his address took up the question of racial differences in mental traits.

Our inveterate love for types and sharp distinctions, he said, is apt to stay with us even after we have become scientific, and vitiate our use of statistics to such an extent that the average becomes a stumbling-block rather than an aid to knowledge. We desire, for example, to compare the brain weights of whites and of negroes. We weigh the brains of a sufficient number of each race—or let us, at least, assume the number to be sufficient. When our measurements are all obtained and spread before us, they convey to the unaided eye no clear idea of a racial difference, so much do they overlap. If they should become jumbled together, we should never be able to separate the negroes from the whites by aid of brain weight; but now we cast up the average of each group and find them to differ, and though the difference is small, we straightway seize on it as the important result, and announce that the negro has a smaller brain than the white. We go a step further, and class the white as a large-brained race, the negro as a small-brained. Such transforming of differences of degree into differences of kind, and making antitheses between overlapping groups, partakes not a little of the ludicrous.

We seem to be confronted by a dilemma; for the group, as a whole, is too unwieldy to grasp, while the average, though convenient, is treacherous. What we should like is some picture or measure of the *distribution* of a given trait throughout the members of a group; and, fortunately, such measures and pictures can be had. Convenient and compact measures of variability are afforded by the science of statistics, and are of no less importance than the average; but still better, because closer to the actual facts, are graphic or tabular pictures of the distribution of the trait, showing the frequency with which it occurs in each degree. The distribution of a trait is for some purposes more important than the average.

After considering certain precautions and criticisms, Prof. Woodworth dealt in order with the various senses. The point of special interest is, he pointed out, as to whether the statements of many travellers, ascribing to the "savage" extraordinary powers of vision, hearing, and smell, can be substantiated by exact tests. The common opinion, based on such reports, is, or has been, that savages are gifted with sensory powers quite beyond anything of which the European is capable, though Spencer explains that this is a cause of inferiority rather than the reverse, because the savage is thus led to rely wholly on his keen senses, and to devote his whole attention to sense impressions, to the neglect and atrophy of his intellectual powers.

Sight, hearing, smell, touch, the pain sense were each considered in detail, and Prof. Woodworth came to the conclusion that, on the whole, the keenness of the senses seems to be about on a par in the various races of mankind. Differences exist among the members of any race, and it is not improbable that differences exist between the averages of certain groups, especially when these are small, isolated, and much inbred. Some interest, said

Prof. Woodworth later, attaches to tests of the speed of simple mental and motor performances, since, though the mental process is very simple, some indication may be afforded of the speed of brain action. The reaction time test has been measured on representatives of a few races, with the general result that the time consumed is about the same in widely different groups.

Chemical Regulation of the Processes of the Body.

Prof. W. H. Howell, of the Johns Hopkins University, delivered the presidential address in Section K (Physiology and Experimental Medicine). He summarised the present state of knowledge of the chemical regulation of the processes of the body by means of activators, kinases, and hormones. The chief points touched upon are as given in the following brief abstract.

In recent years we have come to understand that the complex of activities in the animal body is united into a functional harmony, not only through a reflex control exerted by the nervous system, but also by means of a chemical regulation effected through the blood or other liquids of the organism. Having referred to Brown-Séquard's generalisation, according to which every tissue of the body in the course of its normal metabolism furnishes material to the blood that is of importance in regulating the activities of other tissues, Prof. Howell said in recent years it has been re-stated in attractive form by Schiefferdecker in his theory of the symbiotic relationship of the tissues of the body. According to this author, we may conceive that among the tissues of a single organism the principle of a struggle for existence, which is so important as regards the relations of one organism to another, is replaced for the most part by a kind of symbiosis, such that the products of metabolism in one tissue serve as a stimulus to the activities of other tissues. From many sides and in many ways facts have been accumulating which tend to impress the general truth that the co-activity of the organs and tissues may be controlled through chemical changes in the liquid media of the body as well as through nerve impulses, but in physiology, at least, we owe the definite formulation of this point of view to Bayliss and Starling. Starling's convenient term of "hormone" as a general designation for such substances has served to give a wide currency to the conception.

In treating this subject one must consider also the more or less nearly related instances of combined activity of a chemical sort which are expressed by such terms as chemical activators, kinases, and co-ferments. These terms, like that of hormone, are relatively new; they have been brought into existence by investigators to explain or to express special reactions connected with metabolism, and particularly with the action of ferments. The word activator has reference to the fact, long known, that the ferments, or some of them at least, are secreted in an inactive form, a proferment, which is activated or converted to an active form by a reaction with some definite substance produced elsewhere in the body.

The term kinase is used at present in animal physiology in connection with two reactions only. In both cases it refers to an activating process where the activator is a colloidal substance of unknown composition.

In addition to the activators of the inorganic and the colloidal type, there is perhaps a third kind of activation exemplified in the substances known as co-enzymes or co-ferments. This term may be used to define that kind of cooperative activity between an enzyme and some other non-colloidal substance which we see illustrated in the influence of the bile salts upon pancreatic lipase. The process differs from activation of a proferment to a ferment only in that the combination of the enzyme with its activator is dissociable instead of being permanent. By dialysis or otherwise the co-enzyme can be separated from the enzyme, and the action of the two may be tested separately or in combination. Starling defines hormones as chemical messengers which, formed in one organ, travel in the blood stream to other organs of the body and effect correlation between the activities of the organ of origin and the organs on which they exert their specific effect. Such substances belong to the crystalloid rather than the colloid class; they therefore are thermostable, and do not act as antigens when injected into the living animal.

The substances of known composition which may be regarded as playing the *rôle* of hormones are few in number, three or four at most, as follows:—first, the carbon dioxide formed in the tissues, particularly in muscle during contraction; secondly, the adrenalin of the adrenal glands, which in some way, directly or indirectly, makes possible the full functional activity of the involuntary musculature of the body; thirdly, the hydrochloric acid produced in the stomach, which stimulates the formation of secretin in the duodenal epithelium; and, fourthly, possibly the iodothyrin of the thyroid gland, with its dynamogenic effect upon the neuro-muscular apparatus of the body. In addition, there are a number of hormones of unknown composition which have been either proved or assumed to exist, and are held responsible for certain well-known correlations of function.

Method and Matter of Science.

Under the title "Science as Subject-matter and as Method," Prof. John Dewey, of Columbia University, in his presidential address to Section L (Education), introduced the question of how far the science teaching in schools has up to the present been educational in the true sense.

All, he said, who are much interested in securing for the sciences the place that belongs to them in education feel a certain amount of disappointment at the results hitherto attained. The glowing predictions made respecting them have been somewhat chilled by the event. Of course, this relative shortcoming is due in part to the unwillingness of the custodians of educational traditions and ideals to give scientific studies a fair show. Yet in view of the relatively equal opportunity accorded to science to-day compared with its status two generations ago, this cause alone does not explain the unsatisfactory outcome. Considering the opportunities, students have not flocked to the study of science in the numbers predicted, nor has science modified the spirit and purport of all education in a degree commensurate with the claims made for it. The causes for this result are many and complex. One influential cause, the remedy for which most lies with scientific men themselves, is that science has been taught too much as an accumulation of ready-made material with which students are to be made familiar, not enough as a method of thinking, an attitude of mind, after the pattern of which mental habits are to be transformed.

The infinitely extensive character of natural facts and the universal character of the laws formulated about them is sometimes claimed to give science an advantage over literature; but viewed from the standpoint of education, this presumed superiority turns out a defect; that is to say, so long as we confine ourselves to the point of view of subject-matter. Just because the facts of nature are multitudinous, inexhaustible, they begin nowhere and end nowhere in particular, and hence are not, just as facts, the best material for the education of those whose lives are centred in quite local situations and whose careers are irretrievably partial and specific. If we turn from multiplicity of detail to general laws, we find, indeed, that the laws of science are universal, but we also find that for educational purposes their universality means abstractness and remoteness.

One of the most serious difficulties that confronts the educator who wants in good faith to do something worth while with the sciences is their number and the indefinite bulk of the material in each. At times it seems as if the educational availability of science were breaking down because of its own sheer mass. There is at once so much of science and so many sciences that educators oscillate helpless, between arbitrary selection and teaching a little of everything. Science teaching has suffered because science has been so frequently presented just as so much ready-made knowledge, so much subject-matter of fact and law, rather than as the effective method of inquiry into any subject-matter.

We define science as systematised knowledge, but the definition is wholly ambiguous. Does it mean the body of facts, the subject-matter? Or does it mean the processes by which something fit to be called knowledge is brought into existence, and order introduced into the flux of experience? That science means both of these things will doubtless be the reply, and rightly; but in the order both of time and of importance, science as method precedes

science as subject-matter. Systematised knowledge is science only because of the care and thoroughness with which it has been sought for, selected, and arranged. Only by pressing the courtesy of language beyond what is decent can we term such information as is acquired ready-made, without active experimenting and testing, science. The force of this assertion is not quite identical with the commonplace of scientific instruction that text-book and lecture are not enough—that the student must have laboratory exercises. A student may acquire laboratory methods as so much isolated and final stuff, just as he may so acquire material from a text-book. One's mental attitude is not necessarily changed just because he engages in certain physical manipulations and handles certain tools and materials. This problem of turning laboratory technique to intellectual account is even more pressing than that of utilisation of information derived from books. Almost every teacher has had drummed into him the inadequacy of mere book instruction, but the conscience of most is quite at peace if only pupils are put through some laboratory exercises. Is not this the path of experiment and induction by which science develops?

It must not be supposed that, in dwelling upon the relative defect and backwardness of science teaching, the intention is to deny its absolute achievements and improvements, but it must be pointed out that only to a comparatively slight extent has the teaching of science succeeded in protecting the so-called educated public against recrudescences of all sorts of corporate superstitions and silliness.

It is not to be expected that our schools should send forth their students equipped as judges of truth and falsity in specialised scientific matters; but that the great majority of those who leave school should have some idea of the kind of evidence required to substantiate given types of belief does not seem unreasonable. Nor is it absurd to expect that they should go forth with a lively interest in the ways in which knowledge is improved and a marked distaste for all conclusions reached in disharmony with the methods of scientific inquiry.

The future of our civilisation depends upon the widening spread and deepening hold of the scientific habit of mind, and the problem of problems in our education is therefore to discover how to mature and make effective this scientific habit. Mankind, so far, has been ruled by things and by words, not by thought, for until the last few moments of history humanity has not been in possession of the conditions of secure and effective thinking. Without ignoring in the least the consolation that has come to men from their literary education, it is not too much to say that only the gradual replacing of a literary by a scientific education can assure to man the progressive amelioration of his lot. Unless we master things we shall continue to be mastered by them; the magic that words cast upon things may indeed disguise our subjection or render us less dissatisfied with it, but, after all, science, not words, casts the only compelling spell upon things.

The modern warship seems symbolic of the present position of science in life and education. The warship could not exist were it not for science—mathematics, mechanics, chemistry, electricity supply the technique of its construction and management; but the aims, the ideals in the service of which this marvellous technique is displayed, are survivals of a pre-scientific age, that is, of barbarism. Science has as yet had next to nothing to do with forming the social and moral ideals for the sake of which she is used. Even where science has received its most attentive recognition, it has remained a servant of ends imposed from alien traditions. If ever we are to be governed by intelligence, not by things and by words, science must have something to say about *what* we do, and not merely about *how* we may do it most easily and economically; and if this consummation is achieved, the transformation must occur through education, by bringing home to men's habitual inclination and attitude the significance of genuine knowledge and the full import of the conditions requisite for its attainment. Actively to participate in the making of knowledge is the highest prerogative of man and the only warrant of his freedom. When our schools truly become laboratories of knowledge-making, not mills fitted out with information-hoppers, there will no longer be need to discuss the place of science in education.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—Committees of members and friends of the University have procured contributions amounting to some 1500*l.* for the purpose of commemorating the services of Dr. John Cleland, regius professor of anatomy from 1877 to 1909, and Dr. William Jack, professor of mathematics from 1879 to 1909, who retired last year. It has been decided to present to the University a portrait of Dr. Cleland, painted by Sir George Reid, with a replica for Mrs. Cleland; and a portrait of Dr. Jack, painted by Sir James Guthrie, and also a prize, to be awarded at intervals, for the best thesis on a mathematical subject approved for the degree of Doctor of Science during the preceding period.

The University Court and Senate have had under consideration a proposal, emanating from the general council of graduates, for the establishment within the University of an order of independent lecturers, analogous to *privat-docenten*, who should give courses of lectures qualifying for graduation, and duplicating those already given by the regular professors and lecturers. The new lecturers were to be provided with class-room accommodation, and were to depend for their remuneration on the amount of fees received from students attending their classes. After a prolonged discussion, in which the Senate expressed the opinion that the proposal was not likely to contribute to educational efficiency, and the finance committee that it would seriously disarrange the University funds, the Court decided that effect could not be given to the scheme under the existing constitution of the University.

The University Court has sanctioned the establishment of a new course of instruction in chemistry, including metallurgical chemistry, for students of engineering. The course will be given by Dr. Cecil H. Desch, and will extend over the first two terms of the session. The ordinary course by Prof. Ferguson will be attended by students of arts, medicine, and pure science. Dr. Desch announces a course in metallography during the summer session.

THE Civil Service Estimates in class iv. (education, science, and art), just issued as a White Paper, show a net increase for 1910–11 of 697,718*l.* over the figures for 1909–10. The total estimates of 18,651,483*l.* for the ensuing year include the following:—Board of Education, 14,064,677*l.*, increase 417,663*l.*; British Museum, 175,895*l.*, decrease 3333*l.*; scientific investigation, &c., 74,228*l.*, increase 9764*l.*; universities and colleges, Great Britain, and intermediate education, Wales, 218,100*l.*, increase 700*l.* Scotland: public education, 2,253,725*l.*, increase 106,434*l.*; Ireland: public education, 1,656,901*l.*, increase 34,980*l.*; endowed school commissioners, 925*l.*, increase 5*l.*; universities and colleges, 168,080*l.*, increase 139,930*l.*; Queen's Colleges, nil (last year 4700*l.*).

A DEPUTATION from the Trade Union Congress waited upon Mr. Runciman, President of the Board of Education, on March 17 to urge, among other matters, technical training in day-time classes, the raising of the school age, entirely free secondary education, and the appointment of a Royal Commission to inquire into the misappropriation of educational endowments. In replying, Mr. Runciman said he hopes that by next Session a Bill will be introduced which will deal partly with the raising of school age and partly with the question of day technical classes. If day technical classes are to be of much use, there must be pressure brought to bear on employers. All educationists desire to see the school age raised. Children who leave school at thirteen or fourteen know practically nothing about arithmetic or writing with ease. This deplorable state of things can be remedied in two ways, by raising the school age and by bringing the technical classes nearer to them. Trade unionists, he said, can do as much towards the advancement of education as Parliament can. Dealing with free places in secondary schools, Mr. Runciman said that, taking the whole of the secondary schools of this country in 1907–8, there were 2 per cent. more than the 25 per cent. standard, while in 1909–10 31 per cent. of the total places in the secondary schools were free places.

The State is making a change in many of the endowed charities which are scattered all over the country. In the course of time it will be possible, not only to apply the whole of the educational endowments to the original purposes of their founders, but to combine the small endowments so as to make them effective.

THE issue of the Journal of the Association of Teachers in Technical Institutions for January contains a paper by Mr. John Wilson, the president of the association, on the relation of the technical institution to the modern university. After commenting upon the advanced character of much of the teaching carried on in technical institutions, and mentioning the creditable amount of research work published yearly by the staffs and senior students of these schools and colleges, Mr. Wilson gave some interesting statistics as to the students who graduated in science at the University of London during 1909. It appears that altogether 292 candidates were awarded the degree of B.Sc., and that 57 of these studied entirely at technical institutions, while if the students who did part of their work at a technical institution are included, the number reaches 80. Mr. Wilson also gives the numbers of registered "internal" students and "recognised" teachers in London polytechnics, and compares the total with those in the case of certain other London colleges. During the session 1908–9, the number of registered internal students in the faculty of science was:—at University College, 224; King's College, 175; East London College, 162; and at eight "recognised" polytechnics, 372. In these eight polytechnics there are 94 "recognised" teachers of arts, science, and engineering. In other words, the polytechnics have become important centres of university work. Mr. Wilson maintains that the success of even the limited recognition of London polytechnics by the University of London clearly points to the desirability of the extension of that recognition by the University and to a widely increased measure of recognition of local technical institutions by the provincial universities.

AT a meeting of the Royal Dublin Society on March 9 Prof. Senier delivered a lecture on "The University and Technical Training." From the account of the meeting in the *Irish Times* of March 10 we learn that Prof. Senier considered four types of institutions for the advancement and diffusion of learning and of its applications to society; institutions of acknowledged university rank or residential college universities, exemplified by Oxford; the research university, as seen at Berlin; the examination university, first known in Napoleon's University of Paris; and the technical research university, Charlottenburg. In England, he said, where numerous new universities have been established in recent years, the type adopted has been a combination of the German Research University and the German Technical Research University, the one or the other type predominating, according to local needs, and the whole adapted to its surroundings, particularly to the conditions of secondary education. Whatever view may be held respecting the German practice of separating these two types, as adapted to German conditions, Prof. Senier thinks that for the conditions which prevail in the British Isles the combination of the two in new universities is a wise arrangement. The two new universities in Ireland are also of this combined type, and are to be adapted to Irish educational conditions and the needs of the country. After directing attention to the influence Liebig exerted through his students in the direction of scientific research, Prof. Senier said so great is that influence that science laboratories after the model of Giessen have become the recognised attribute of science professorships throughout the world. Another advantage possessed by the German university is the character of the leaving examination of the secondary school. It corresponds to a matriculation examination, with the added knowledge acquired by about two years' university study in arts, and its acceptance by the university as evidence of sufficient knowledge for matriculation relieves the university of the practice of giving the student an examination as his first experience on entering. In Prof. Senier's opinion secondary schools should abandon all attempts to teach experimental science. To rival the work of the German universities the better organisation and coordination of the entire educational system is necessary. Germany has built up a chemical industry with tens of millions of pounds annually through the agency of research chemists, methodically trained in technical schools. German manufacturers know the value in dividends of the services of trained research chemists; Irish and English manufacturers do not.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, February 25.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Prof. J. **Perry**: Telephone circuits. The author published a paper in the Proceedings of the society in 1893 showing how voltage v and current c are attenuated along a telephone or submarine telegraph line, a line with resistance r, capacity k, inductance l, and leakance s per unit length; currents are of the form $\sin qt$. When lq/r is considerable the mathematical expressions become simple. It was pointed out that the introduction of l is of great benefit. The author now points out that k may be made negative by the use of inductance leaks to earth, and l may be made negative by the use of condensers in series with the line. To introduce l, as Mr. Pupin has done, by inductance coils at equidistant places on the line, or to introduce the other properties mentioned by placing other contrivances at equal distances, is a mathematical problem of great complexity. Contrivances placed close together have the same effect as the continuous distribution of properties, but there is considerable expense; the problem is to find how far apart the contrivances may be placed so that the effect produced shall still be beneficial. Mr. Pupin has given a rule for the spacing of his coils, but practical men dispute its accuracy; nobody has given a rule for other contrivances; the object of the author is to give an easy method of calculation which is practically correct, and can be used when the contrivance is any network or other combination of resistances, inductances, and capacities—some being leaks to earth—and it may include transformers, motors, and generators. Suppose there are contrivances at the equidistant places A, B, &c., m miles apart in a cable which has the above-mentioned properties r, k, l, and s. There is a contrivance the terminals of which are A and A_0, another the terminals of which are B and B_0; between A_0 and B there is m miles of cable. Let the currents in the line at A, A_0, and B be c, c_0, and C. Let the voltages at these points be v, v_0, and V. The assumption on which the whole method is based is that $V/C=v/c=\rho$. This is practically true everywhere in a long line except near the ends. Now whatever be the nature of the contrivance, we can calculate v_0 and c_0 from v and c. It is also known that

$$V=v_0\cosh mn+\frac{r+lqi}{n}c_0\sinh mn,$$

$$C=c_0\cosh mn+\frac{n}{r+lqi}v_0\sinh mn,$$

when

$$n=\sqrt{(r+lqi)(s+kqi)}.$$

Putting V/C or ρ equal to v/c, we have a quadratic to calculate ρ, and therefore V and C, and the problem is solved. Taking $c=\sin qt$ and calling it 1, then $v=\rho$. Whatever the contrivance may be, we find that $V=\alpha+\beta\rho$ and $C=a+b\rho$, where α, β, a, and b are given in value; they are usually unreal quantities of the form $M+Ni$, where i is $\sqrt{-1}$. Solving for ρ, and finding C, we have two answers which are reciprocals of one another. If $\frac{1}{2}(a+\beta)$ be called P, and this is very easily evaluated, then

$$C=P\pm\sqrt{P^2-1}$$

Examples of the use of the method are given, some showing that the detached contrivances produce much the same and others very different effects from what might have been expected from a study of the cable with continuous properties. It was shown that a line may have contrivances somewhat far apart which will tune it to a musical note merely, so that it acts almost like an ohmic resistance, but which will not transmit well the currents of other frequencies, and that for the commercial transmission

of speech there must be a compromise. The author laid stress upon the fact that his method of calculation could be taught to quite non-mathematical people.—Prof. C. H. **Lees**: The laws regarding the direction of thermo-electric currents enunciated by M. Thomas.—H. R. **Nettleton**: New method of determining thermal conductivity.

Mineralogical Society, March 15.—Prof. W. J. Lewis, F.R.S., in the chair.—G. W. **Grabham**: A new form of petrological microscope, with notes on the illumination of microscopic objects. The new instrument, which is of the "Dick" or "English" pattern, has a focussing substage carrying a series of condensers mounted on a triple nose-piece, each capable of being inserted in the axis of the instrument. A new explanation was given of the "Becke" or bright-line effect, especially applicable to parallel polarised light traversing mineral sections, which meet along inclined junctions.—W. F. P. **McLintock**: Datolite from the Lizard district. Datolite, which is associated with calcite, chalcopyrite, and natrolite (rare) in veins and geodes at the junction of the serpentine and hornblende schist, Parc Bean Cove, Mullion, Lizard district, Cornwall, occurs in crystals measuring up to 2 cm. along the *b* axis, and displayed fourteen forms, of which two were new. An analysis gave SiO_2, 37·45; CaO, 34·67; Fe_2O_3 and Al_2O_3, 0·57; B_2O_3, 21·87; H_2O, 5·67; total, 100·23.—Arthur **Russell**: Additional notes on the occurrence of zeolites in Cornwall and Devon. The occurrence of heulandite, a mineral hitherto not recorded from Cornwall, at Carrick Du Mine, St. Ives, Cornwall, was described; also of chabazite and heulandite at the Ramsley Mine, South Tawton, Devon.—Dr. J. W. **Evans**: A modification of stereographic projection. Faces below the plane of projection are represented by the same points as parallel faces above it, upper faces being distinguished by a plus, and lower faces by a minus, sign.—Dr. J. W. **Evans**: Axes of rotatory symmetry. Coincidence is complete or codirectional when equivalent lines and their directions coincide, incomplete or contradirectional when equivalent lines coincide, but equivalent directions of uniterminal lines are opposed; in both cases it is colinear. If a minimum rotation of $2\pi/n$ result in codirectional, contradirectional, or colinear coincidence, the axis of rotation has codirectional, contradirectional or colinear symmetry, with cyclic number n.—Prof. H. L. **Bowman** exhibited models illustrating space-lattices and Sohncke's point-systems.

DUBLIN.

Royal Dublin Society, February 22.—Mr. R. M. Barrington in the chair.—Prof. W. **Brown**: Chrome-steel magnets. Eight steels containing from 1·75 to 9·22 per cent. of chromium were tested for magnetic moment per gram, the best result being obtained with a magnet which contained about 2·5 per cent. of chromium.—W. J. **Lyons**: The distribution of mean annual rainfall over the counties of Dublin, Wicklow, Kildare, and Meath. The rainfall over this area varies from below 28 inches to probably more than 60 inches in a very marked manner, closely related to the very striking orographical features of the area. The author suggested that the recognised action of hills in producing condensation by causing ascensional currents was not an adequate explanation of the marked increase found in the rainfall of hilly districts. He thought it probable that mountains facilitated the processes of rain development, apart from any influence on condensation.—Prof. W. F. **Barrett**: A simple form of open-scale barometer. In form this instrument resembles an air thermometer, only that it indicates variations of atmospheric pressure and is almost insensible to changes of temperature. This is accomplished by making use of a Dewar's liquid-air flask as the air receptacle, into which is sealed a quill glass tubing containing an index of a dense non-conducting liquid. The tube is open to the air at one end, and is sealed into a wider glass tube which surrounds it, and from which the air has been exhausted as completely as possible. It is found in practice that the readings correspond fairly well with those of an ordinary barometer, and as it can be made as sensitive as desired by altering the ratio of the capacities of the bulb and index tube, it is adapted for domestic use as a weather-glass, and claims to be nothing more.

PARIS.

Academy of Sciences, March 14.—M. Émile Picard in the chair.—Henri and Jean **Becquerel** and H. Kamerlingh **Onnes**: The phosphorescence of uranyl salts at very low temperatures. The changes observed in the absorption spectra at temperatures down to that of liquid air have been described in a previous paper. In the present paper details of the spectra are given for the temperatures of 80° C. absolute (boiling nitrogen) and 14° C. absolute (solid hydrogen). The bands approach asymptotically a limiting position as the temperature is lowered. A very strong magnetic field (35,000 Gauss) is without influence on the spectra. Ordinary phosphorescent spectra appear to be due to the effect of traces of impurities in the phosphorescent substance; this is not the case with uranyl salts; the spectra appear to be due to the uranium itself.—H. **Deslandres** and P. **Idrac**: The spectrum of the comet 1910*a*. The arrangement of the spectrograph used is described, and the wave-lengths of the lines observed given. The bands of hydrocarbons and cyanogen were identified.—J. **Boussinesq**: The vertical propagation, at great depths, of the movement of waves by emersion in the case of a canal or basin indefinite horizontally.—MM. **Haller** and Ed. **Bauer**: The alkylation of the fatty ketones by the use of sodium amide. The decomposition of the hexa-alkylketones. Diethylketone has been methylated by sodium amide and methyl iodide, ethyl-isopropylketone, di-isopropylketone, a high boiling condensation product, and tetramethyl-ethylketone, being produced. The hexa-alkylacetones are split up by sodium amide, a trialkylmethane and trialkylacetamide arising from the reaction.—Prof. Hittorf was elected a foreign associate.—Charles **Nordmann**: The absorbing atmospheres and the intrinsic luminosities of some stars.—Jules **Baillaud, J. Chatelu,** and M. **Giacobini**: Observation of a minor planet at the Observatory of Paris. The traces of this planet were first noticed by Jules Baillaud on a negative of the international chart of the sky taken on March 3. Observations are tabulated for March 3, 5, 7, 8, 10, and 11.—Frédéric **Riesz**: Certain systems of functional equations and the approximation of continued functions.—L. **Remy**: The algebraic surfaces representable on that of Kummer.—H. **Larose**: The equation of telegraphists.—E. **Estanave**: The simultaneous production of stereoscopic relief and of changing aspect in the photographic image.—Pierre **Weiss** and Kamerlingh **Onnes**. The saturation intensity of magnetisation at very low temperatures. The intensities of saturation have been measured at the ordinary temperature and at the temperature of boiling hydrogen (20° C. absolute) for nickel, iron, and magnetite. The results for cobalt were not satisfactory.—Pierre **Weiss** and Kamerlingh **Onnes**: The magnetic properties of manganese, vanadium, and chromium. For these metals at the temperature of solid hydrogen (14° C. absolute) there was expected either the appearance of ferromagnetic phenomena or a paramagnetism considerably increased according to Curie's law. It was found experimentally that neither of these effects was produced, the magnetic phenomena remaining very slight. The theoretical consequences of these facts are discussed.—P. **Vaillant**: A particular case of evaporation. A study of the diffusion of the vapour arising from a liquid in a cylindrical tube the length of which was great in proportion to its diameter.—Ch. **Féry**: A new reflectometer. A hemispherical cavity is formed in a block of plane glass, and the hole exactly filled by a hemispherical block of glass of the same curvature. The drop of liquid the refractive index of which is to be measured is placed between the two blocks, and the radius of the dark ring formed by total reflection measured. From this and the corresponding radius of the dark ring when air is between the two blocks the index of refraction can be determined with an accuracy of about 0·005.—L. **Bloch**: Chemical actions and ionisation by bubbling. It is shown that the ionisation produced when gases are evolved from a liquid is the result of actions in the liquid surface.—O. **Boudouard**: The testing of metals by the study of the damping of vibratory movements.—M. **Vèzes**: The analysis of essence of turpentine by curves of miscibility. The author's results generally confirm those of M. Louise, but some differences are pointed out.—M. **Lecoq**: A colloidal solution of pure metallic arsenic. A colloidal

solution of arsenic can be obtained by the electrolysis of an alkaline solution with arsenic for the anode, or by the electro-reduction of an alkaline solution of arsenious acid. The properties of the solutions thus obtained are described in detail.—J. B. **Senderens**: The catalysis of the aromatic acids. A study of various catalytic substances shows that only thoria, zirconia, and green oxide of uranium are of practical use in this reaction, and of these thoria has the preference. More than thirty aromatic mixed ketones have been obtained by the application of this reaction.—F. **Couturier**: The stability of the β-keto-aldehydes.—G. **Darzens**: A new method of synthesis of unsaturated ketones. Stannic chloride can replace aluminium chloride with advantage in reactions between acetyl chloride and hydrobenzenes. The experiments described have a bearing on the theory of the Friedel and Crafts reaction.—G. **Malfitano** and Mlle. A. **Moschkoff**: The coagulation of starch material by freezing.—L. **Ravaz**: Researches on the specific reciprocal influence of the subject on the graft in the vine.—G. **André**: The development of a bulbous plant: variations in the weight of nitrogen and the mineral matters.—M. **Biéler-Chatelan**: The estimation of assimilable potash in soils. It is concluded that the amount of potash extracted by a solution of carbon dioxide in water gives results that are best comparable with the actual culture experiments.—J. **Tissot**: The experimental study of intra-organic combustions in animals breathing air progressively deprived of oxygen, and the natural methods of defence of the organism against anoxyhæmia.—F. **Maignon**: The influence of the genital glands on glycogen production.—M. **Ranjard**: Contribution to the study of audition and its development by the vibrations of the vowel siren.—H. **Dominici**, G. **Petit**, and A. **Jaboin**: The persistent radio-activity of the organism resulting from the intravenous injection of an insoluble salt of radium, and on its applications. One milligram of radium sulphate was injected into a horse, and the distribution of the radio-activity studied. The effects could be traced for more than six months after the date of the injection.—Mlle. **Cernovodeanu** and Victor **Henri**: The action of the ultra-violet rays on micro-organisms and on different cells. Microchemical study. The ultra-violet rays produce chemical and physical transformations in protoplasm which modify completely all the colour reactions. This action of the rays is quite different from that of heat, hydrogen peroxide, or ordinary fixing agents.—J. **Nageotte**: The activity of the myeline sheath in nerves separated from the organism.—H. E. **Sauvage**: The Andersh ganglion in the horned Phrynosome.—P. **Hachet-Souplet**: The education of animals by man as a means of psychological research.—L. **Bordas**: General considerations on the Malpighi tubes of the larvæ of Lepidoptera.—Paul **de Beauchamp**: The existence and conditions of parthenogenesis in Dinophilus.—A. **Rodet** and M. **Lagriffoul**: The serotherapy of typhoid fever. Clinical results. In the greater proportion of the cases cited the disease has been arrested at the twelfth day or later. If the serum is administered at the eleventh day, at the latest, it appears to exert a beneficial influence on the course of the disease.—A. **Trillat** and M. **Sauton**: The influence of vitiated atmospheres on the vitality of microbes.—P. and N. **Bonnet**: The existence of the Trias and Mesojurassic in the neighbourhood of Djoulfa, southern Transcaucasia.—Const. A. **Ktenas** and Ph. **Négris**: The presence of layers containing Ellipsactinia in the Vardusa mountains and in Ætolia, in Greece.—Albert Michel **Lévy**: The pechstein strata in the Esterel.—Albert **Nodon**: Researches on terrestrial magnetism.—Henryk **Arctowski**: Some anomalies in the distribution of atmospheric pressure in the United States.

FORTHCOMING CONGRESSES.

May 16–21.—International Congress of Americanists. Buenos Ayres. General Secretary: Dr. Lehmann-Nitsche, Calle Viamonte 430, Buenos Ayres, Argentine Republic.

May 14–22.—International Botanical Congress. Brussels. General Secretary: Dr. E. de Wildeman, Jardin botanique, Bruxelles.

June.—International Congress of Mining, Metallurgy, Applied Mechanics and Practical Geology. Düsseldorf. General Secretaries: Dr. Schrödter and Mr. Löwenstein, Jacobi-strasse 3/5, Düsseldorf, Germany.

July 27–31.—International Congress on the Administrative Sciences. Brussels. Secretary of British Committee: Mr. G. Montague Harris, Caxton House, Westminster.

August 1–6.—International Congress of Entomology. Brussels. Chai[rman] of Local Committee for Great Britain: Dr. G. B. Longstaff, Highland[s], Putney Heath, S.W.

August 1–7.—French Association for the Advancement of Scienc[e]. Toulouse. President: Prof. Gariel. Address of Secretary: 28 ru[e] Serpente, Paris.

August.—International Congress of Photography. Brussels. Corre[spondent] for United Kingdom: Mr. Chapman Jones, 11 Eaton Ris[e], Ealing, W.

August.—International Congress of School Hygiene. Paris. Secretary: M. Dufestel, 10 Boulevard Magenta, Paris.

August 15–20.—International Zoological Congress. Graz (Austria). President: Prof. Ludwig von Graff. Address for inquiries: Präsidiu[m] des VIII. Internationalen Zoologen-Kongresses, Universitätsplatz 2, Gr[az] (Österreich).

August 18–26.—International Geological Congress. Stockholm. Gener[al] Secretary: Prof. J. G. Andersson, Stockholm 3.

August 31 to September 7.—British Association. Sheffield. President: Prof. T. G. Bonney, F.R.S. Address for inquiries: General Secretarie[s], Burlington House, W.

September 6–8.—International Congress of Radiology and Electricit[y]. Brussels. General Secretary: Dr. J. Daniel, 1 rue de la Prévôte, Brussel[s]. Correspondents for United Kingdom: Prof. Rutherford and Dr. W. Makower, University of Manchester, and Dr. W. Deane Butcher, Holyroo[d], Ealing, W.

September 18–24.—German Association of Naturalists and Physician[s]. Königsberg. Secretaries: Prof. Lichtheim and Prof. F. Meyer, Drumn str. 25–29, Königsberg.

September 27–30.—International Physiological Congress. Vienn[a]. President: Prof. S. Exner. General Secretary for United Kingdom: Prof. E. B. Starling, University College, London, W.C.

October 6–12.—Congrès International du Froid. Vienna. Correspo[n]dent for United Kingdom: Mr. R. M. Leonard, 3 Oxford Court, Cann[on] Street, E.C.

CONTENTS. PAG[E]

THURSDAY, MARCH 31, 1910.

A FRENCH TREATISE ON PHYSICAL GEOGRAPHY.

Traité de Géographie physique: Climat, Hydrographie, Relief du Sol, Biogéographie. By Prof. Emmanuel de Martonne. Pp. viii+910, and maps. (Paris: Librairie Armand Colin.) Price 22 francs.

EVERY writer of text-books is faced by the difficulty that the science of which he treats inosculates with and is overlapped by other branches of science. One of his most important tasks, therefore, consists in the exercise of a wise judgment as to what should be properly included, and what excluded, in the treatise he is preparing.

It has sometimes been suggested that all science may be regarded as falling into the two divisions geography and astronomy, the former dealing with everything that relates to our own planet, the latter with matters concerning the outside universe. But however logical such a scheme of classification of the sciences may be regarded, it cannot be commended on the score of convenience. There is no branch of physical or natural science which is not a part of "earth-knowledge," but it would be clearly impossible in a single treatise to deal with the foundations and superstructures of physics, chemistry, geology, botany, zoology, and anthropology. A work on geography must take for granted a certain amount of preliminary knowledge of science, and be contented with showing their application to the explanation of the various phenomena exhibited on the surface of the globe.

In the preface to the work before us, its author suggests as natural divisions of physical geography the following:—Morphologie, l'hydrographie, le climat, la biogéographie, et la géographie humaine; and the bulky volume now issued deals only with the first four of these divisions. The author justly remarks that it is almost impossible for any man to have a complete personal knowledge of all these subjects, but that specialisation becomes necessary; he has therefore sought and obtained assistance from various colleagues and friends in dealing with different departments of the subject.

In the first division of the work, devoted to general notions on the subject, a clear account, occupying 25 pages, is given of the history and evolution of geological science, and in this part, as in all following divisions, a very useful and complete bibliography of the subject is supplied. The question of projection is fully treated, and, for the very numerous maps of the whole globe given throughout the work, the conventional system of Molweide (or Babinet) is adopted in preference to that of Mercator, thus avoiding the extreme polar distortions of the latter system.

The 160 pages devoted to meteorology, and constituting the second division of the work, contains an excellent summary of that branch of science. The chief meteorological instruments are described, and clear statements given on the temperature, the hygroscopic characters, and the movements of the atmosphere in different areas; and the bearings of these several factors in producing different types of climate are discussed with much skill.

The subject of hydrography has more than 100 pages devoted to it, and constitutes the third division of the book. A good *résumé* of the observations made in recent years in the deep oceans is given with abundant references, including those to the latest published works. This is followed by chapters on the movements of the oceanic water, on the lakes, and on the rivers of the globe.

The fourth part of the work, dealing with the forms of the great land masses of the globe, constitutes the largest division of the book, occupying no fewer than 340 pages. After a sketch of the methods employed in surveying and of the different ways of representing the results on maps, a list is given of the chief published topographical maps of different parts of the world. We notice here some singular omissions. The Ordnance maps of England and Wales and of Scotland, on the one-inch scale, are referred to, but there is no mention of the existence of maps on other scales, or of any of the Ordnance maps of Ireland! The maps of the trigonometrical survey of India are included, but no notice is taken of any British colony, although Algeria and Tunis receive full consideration. This is a matter which certainly calls for rectification in a future edition.

The forms of the land surfaces resulting from different kinds of erosion are dealt with somewhat fully on the lines rendered familiar by the writings of Prof. W. M. Davis. Under the title of palæogeography a chapter is devoted to the forms and dimensions of landmasses during former geological periods, and the somewhat problematical questions connected with the subject are dealt with in considerable detail. The map of "Gondwanaland" on p. 587, in which the great continent of Permo-Carboniferous times is made to include, not only India and a large part of Africa, but to extend over Australia and the western half of South America, will naturally excite criticism from those who believe in the permanance of ocean-basins; as will also the map of the world in Cenomanian times, in which, following de Lapparent, Haug, and Frech, the author represents a northern and a southern Atlantis, and, more doubtfully, a Pacific continent. The chapters on glacial and desert conditions, and the surface features resulting from them, are fully up to date, and contain much useful information of a kind not usually found in text-books.

In the 180 pages devoted to "biogeography" there is much useful information included, but opinions will differ as to how far much of this matter should legitimately form a part of a treatise on physical geography. Such subjects as commensalism in plants and animals, the fertilisation of plants, domestication and its influence, mutation and saltation—important as they undoubtedly are—seem scarcely to form a portion of *geographical* science, and if they are included it is difficult to understand why many similar questions are omitted.

Apart from this difficult question of the limits which the author should adopt for his subject, the work before us is a mine of information, and especial praise

must be given to the great wealth of useful illustrations it contains. These include 396 figures and maps in the text, 48 plates with very beautiful photographs of scenery, &c., and two folding coloured maps.

J. W. J.

THE PREHISTORIC EVOLUTION OF ITALY.

The Stone and Bronze Ages in Italy and Sicily. By T. Eric Peet. Pp. 528; maps and plates. (Oxford: Clarendon Press, 1909.) Price 16*s.* net.

THIS book gives a clear and exhaustive description of the results of the numerous excavations made by Italian archæologists and a critical discussion of the material obtained. The author succeeds in giving a remarkably complete record of the evolution of culture in Italy from the Palæolithic age down to the Iron age. In arriving at his conclusions he relies almost entirely on technological data, which, though of great value in determining the state of culture of the peoples with which he deals, are of much less value than the data of physical anthropology in solving racial problems. Large numbers of skeletons appear to have been discovered in the immense number of tombs that have been investigated by the Italian archæologists, but only in two or three cases does the author give us the measurements of these skeletons. As a result, many problems have to be left unsolved which with the assistance of physical data would apparently be easily soluble. For instance, a type of Neolithic pottery is found in a cave at Villafrati, in north Sicily, which differs from the Neolithic types found in other parts of the island, and has analogies with pottery found in certain neighbouring countries. The author is unable to decide whether this pottery was introduced by the immigration of a new race or by trade intercourse with foreign countries. He appears to have overlooked the important fact, mentioned by him in a footnote, that four skulls having an average index of 82·2 were found in the same cave as the new type of pottery. Knowing that the average index of the ancient Mediterranean race is 74–75, the physical anthropologist would have no hesitation in saying that the probability was immensely in favour of the new type of pottery being introduced into Sicily by the immigration of a new race.

The difference in the technique of the Neolithic implements and pottery in north and south Italy leads the author to the conclusion that the populations of these regions were two branches of the Mediterranean race who arrived in Italy by different routes. The southern branch almost certainly came by sea from Crete; about the route of the northern branch there is not the same certainty. Towards the end of the Neolithic period, pottery of the "dolmen" type appeared in south Italy, north Sicily, and Sardinia, and superseded the older types.

In the period coming after the Neolithic, which the author, following the Italian archæologists, calls the Eneolithic period, copper makes its appearance alongside of stone. The rock-hewn tomb is introduced in south Italy and Sicily, and a great advance takes place in the technique of stone implements. Several new types of pottery appear. One of these is distinctly Ægean, so there can be no doubt that there was trade intercourse in the Eneolithic period between Crete and south Italy and Sicily.

A remarkable type of pottery occurs in the early Eneolithic period in south-west Sicily in association with rock-hewn tombs. The ornamentation consists of rectilinear patterns painted in black on a ground of "white slip," with which the clay pot is coated. The distribution of this pottery is interesting; it is not found in Crete, but it has been found in Thessaly and in other parts of north Greece; fragments have also been found at Molfetta, in Apulia, south Italy. It looks, therefore, that there was a second route of trade or of migration from the east, across north Greece, the Adriatic, and south Italy to Sicily, which is quite distinct from the Ægean sea route along which the greater part of the trade of south Italy with the east, passed.

The author leans to the view that the great cultural changes of the Eneolithic period were not due to the immigration of a new race, but to foreign influence. Measurements of skulls found associated with the "painted white slip" ware might possibly change this opinion. The average cephalic index of four skulls found at Castelluccio with this ware was 77·9, which looks significantly higher than that of the Mediterranean race.

The Bronze age in Italy is treated topographically. A very painstaking and up-to-date description is given of the material found in the lake dwellings, in the Terremare, and in Bronze-age hut-settlements and caves of north Italy. Chapters are then devoted to the Bronze age in south Italy, and to the Bronze age in Sicily and Sardinia.

In a chapter on the racial problem, the author deals with the racial affinities and origins of the peoples who introduced bronze into Italy. There are two theories in the field, that of Brizio and that of Pigorini. The author favours the latter. According to Pigorini's theory, the hut villages and caverns of the Neolithic age in north Italy were inhabited by a dolichocephalic race (called usually *Ibero-Liguri*) who inhumed their dead. At the end of the Neolithic period a new race appeared in north Italy which cremated its dead. This race planted the first lake dwellings in Lombardy. In the full Bronze age another branch of the same race invaded the eastern district of north Italy, and planted the lake dwellings of the Veneto and the Terremare of Emilia. At the end of the Bronze age, part of the new people crossed the Apennines and entered Tuscany and Latium. This new people Pigorini calls the *Italici*. He considers that they were of the same race as the Swiss lake dwellers, and therefore probably brachycephalic. There is no direct evidence of this, as cremation was an invariable burial custom among the Italian like dwellers and the Terremare folk.

The volume is well printed, contains many excellent illustrations, and four valuable maps showing the distribution of sites in the Neolithic, Eneolithic, and Bronze ages. No student of the prehistory of man in Italy, or indeed in Europe, can dispense with read-

ing this volume. It is, we believe, the first treatise in English which has fully utilised the remarkable archæological discoveries of the last decade in Mediterranean countries, and the author is to be congratulated on the thoroughness and ability with which he has accomplished his task. J. G.

BOTANICAL PHOTOGRAPHS.

Vegetationsbilder. Seventh series. Parts iii. to viii. Part iii., Der nördliche Schwarzwald, by Otto Feucht; part iv., Vegetationsbilder aus Dalmatien, by L. Adamović; part v., Charakterpflanzen des abessinischen Hochlandes, by Felix Rosen; parts vi. and vii., Pflanzenformationen aus Ost-Bolivia, by Th. Herzog; part viii., Vegetationsbilder aus Dänisch-Westgrönland, by M. Rikli. Price 4 marks, each part containing 6 photographs. Edited by Prof. G. Karsten and Prof. H. Schenck. (Jena: Gustav Fischer, 1909–10.)

THIS unique botanical publication is being continually extended, so that a seventh series is now completed. The first double part of the volume, dealing with the colonisation of volcanic lands in Java and Sumatra, has been previously noticed. The third part is devoted to the vegetation of the northern area of the Black Forest, which is characterised by its coniferous trees and moorland. A typical bit of high moor shows bushes of *Pinus montana*, clumps of *Scirpus caespitosus* and tufts of *Juncus squarrosus*. On another plate the same pine is seen as a tall tree, contrasting with the adjacent Scots pine and spruce. The author has also been very successful with his representations of the two subalpines, *Andromeda polifolia* and *Athyrium alpestre*, and of the umbellifer, *Meum athamanticum*. Dr. L. Adamović has brought together a most attractive set of photographs from the sunny climate of Dalmatia. They illustrate a strip of shore and rocks of the littoral, sublittoral and montane regions. So carefully have the spots been chosen and the photographs taken that the author can point out most of the individual plants. Especially charming is the first plate, showing *Aster Tripolium* with species of Statice and *Inula crithmoides* on the shore, and the second picture of sublittoral rock where *Dianthus dalmaticus* and *Iris germanica*, with other plants, are easily recognised. Trees provide the chief feature of the views on the Abyssinian plateau. The rosaceous plant *Hagenia abyssinica*, which tardily assumes its arboreal shape, is very striking; the unripe fruits are esteemed by the natives as a valuable specific for internal complaints. A fine specimen of tree Euphorbia is depicted, which the author suggests may have developed an arboreal form when it passed from a dry to a moist climate. Even more singular is the tree Lobelia, formerly known as Rhynchopetalum. Illustrations are also given of a huge spreading Ficus and a tree Entada.

Dr. Th. Herzog has provided a fine double part relating to the remote territory of East Bolivia. Along the Paraguay, on savannah land subject to inundations, is the home of the wax palm, *Copernicia cerifera*, where it is associated with tall grasses, species of Paspalum and Andropogon. Another plate represents the growth of the palm *Acrocomia Totai*, on the sandstone highlands of Chiquitos. A "monte" or thicket formation occurs on parts of the plain of the Rio Grande, where thorny scrub and succulents predominate; the plates depict species of Cereus, a Trithrinax and the bromeliad *Aechmea polystachya*, which last is valuable to travellers, as it generally holds a store of water. Other palms selected for illustration are *Orbignya palmata* and *Mauritia vinifera*, typical of the savannahs, *Astrocaryum Chonta* and *Iriartea exorrhiza*, denizens of the rain forests; Iriartea produces remarkable thorny prop roots. The last two plates portray succulents, of which *Pilocereus celsianus* is the most striking, on account of its silvery crown of hairs.

The concluding part contains some typical aspects of vegetation in Danish West Greenland. In the southern area birches alone attain to the height of trees as seen in the first plate; the second indicates the importance of *Salix glauca*. A brilliant photograph of an Arctic meadow would be better appreciated if a key to the plants had been supplied. There is an effective photograph of cotton-grass growing by the edge of a lake, and another of clumps of *Glyceria distans* which attract attention on account of the peculiar lie of the stems.

MAGNETIC CHARTS.

Magnetische Kartographie in historisch-kritischer Darstellung. By G. Hellmann. Veröffentlichungen des Kg. Preuss. Meteorologischen Instituts, Abhandlungen, Bd. iii., Nr. 3. Pp. 61. (Berlin: Behrend and Co., 1909.) Price 6 marks.

DR. G. HELLMANN, as head of the Prussian Meteorological Institute, which controls the magnetic observatory at Potsdam, and as a lover and collector of antique magnetic literature, is conspicuously qualified for the work he has undertaken in the present volume. It aims at giving a complete list of all magnetic charts of any importance. All time prior to the year 1700 is regarded by Dr. Hellmann as preceding the era of charts, but he devotes a few pages to Columbus and other pioneers, whose work relates to the discovery that the magnetic needle is usually inclined to the geographical meridian.

Time since 1700 is divided into two periods. The first, extending until 1835, was heralded in by the famous chart of Halley; it is briefly discussed on pp. 10–11. The second period, extending from 1835 to the present day, saw the introduction of magnetic surveys on land.

The earliest work of this kind, according to our author, took place in England on the initiative of the British Association. On pp. 11–17 there is an enumeration of all the principal land surveys; while pp. 18–27 summarise the present state of our knowledge of the distribution of the magnetic elements. There is a useful list on p. 26 of the epochs of the principal surveys since 1891, with particulars as to the number and density of distribution of the stations. A number of propositions are laid down in pp. 28–29 as to the objects to be aimed at in magnetic surveys and other work preliminary to the construction of

charts. The author considers it most important that the exact observational work at sea commenced under the auspices of the Carnegie Institution should be extended as soon as possible to all seas. He advocates international cooperation to ensure continuity in the drawings of magnetic lines in frontier districts, and emphasises the importance of adequate determinations of secular change.

The terminology, units, &c., employed in the description of the charts are explained in pp. 30–31. The charts themselves are divided into those dealing with the whole or the greater part of the earth, those confined to the oceans, those dealing with the several continents, and, finally, those devoted to individual countries or districts. The information given usually includes the area, the epoch, the magnetic element or elements dealt with, the interval—in specified units—between the successive isogonal, isoclinal, or isomagnetic lines, the geographical scale of the map, also the locus and date of publication. The title in each case, when there is one, is given in the original language. There is a separate list on pp. 60–61 of charts based on theory.

The list of charts seems very complete. As evidence that it is up to date may be mentioned the fact that it includes the British and American world charts published respectively in 1906 and 1907, Commander Chetwynd's charts of the South Polar regions published in 1908, Dr. Schmidt's charts of North Germany, and Prof. Beattie's South African charts published in 1909. The volume is clearly printed in good-sized type, and should prove a valuable work of reference.

C. CHREE.

ELECTRICAL BIOGRAPHY.

Makers of Electricity. By Brother Potamian and Prof. James J. Walsh. Pp. vi+404. (New York: Fordham University Press, 1909.)

THIS is not a work on central-station engineers, but a series of biographical sketches of the chief pioneers in the science of electricity in its historical development. Of these sketches there are twelve, as follows:—Peregrinus and Columbus; Norman and Gilbert; Franklin and some of his contemporaries; Galvani; Volta; Coulomb; Oersted; Ampère; Ohm; Faraday; Clerk Maxwell; Lord Kelvin. As the first three, together with those on Oersted and Lord Kelvin, are signed by Brother Potamian, it may be assumed that the rest are by his colleague, Dr. Walsh, who is the author of several others works, "Makers of Modern Science," "Catholic Churchmen in Science," "Makers of Modern Medicine," and "The Popes and Science," which appear to have a great vogue amongst Roman Catholic readers in the United States. Brother Potamian, better known to his English friends as Dr. O'Reilly, is one of those who has made the bibliographical history of electricity his own; and his masterly annotations of the catalogue of the Wheeler collection of electrical books (formerly the library of the late Mr. Latimer Clark) in the possession of the American Institute of Electrical Engineers show him to possess abundant qualifications for writing biographies of the pioneers. If the chapters on Peregrinus and Columbus, Norman and Gilbert, add nothing to previous knowledge, they are valuable in presenting very readable summaries of the results of recent antiquarian research into the achievements of these early investigators of magnetism. The account of Peregrinus is particularly good, and avoids errors too often attaching to accounts of his long-forgotten discoveries. The article on Gilbert is also replete with the details which have been unearthed in recent years, though by a slip on p. 49 he is said to have blamed Stevinus for certain "vain and absurd" views about the variation of the compass in southern regions of the earth. It was not Stevinus whom he blamed, but "certain unnamed Portuguese mariners." Gilbert's Copernican views are discussed fully, and criticised.

Franklin's work in electrical observation is treated at some length, as is natural in a work intended primarily for American readers; but all readers should be grateful for the very clear way in which Brother Potamian has laid out the historical position of Franklin with respect to those contemporaries of his—De Romas, d'Alibard, and Divisch—who have been alleged to have anticipated him with respect either to the kite experiment or the invention of the lightning rod. One amusing reminiscence is recorded in this chapter of the controversy which arose upon knobs *versus* points, and was referred to a committee of the Royal Society. In that committee the Hon. Henry Cavendish and Dr. Benjamin Wilson were opposing partisans. Sir John Pringle, the President of the Royal Society, supported Cavendish in favour of using points. But points had been advocated by Franklin, whom to support at that moment was "unpatriotic." His Majesty George III. accordingly ordered that the points of the lightning conductors at Kew Palace should be replaced by balls; whereupon Sir John Pringle, replying with dignity, "Sire, I cannot reverse the laws and operations of nature," resigned the presidency. This evoked the following witty epigram:—

> While you, great George, for knowledge hunt,
> And sharp conductors change to blunt,
> The nation's out of joint;
> Franklin a wiser course pursues,
> And all your thunder useless views
> By keeping to the point.

The chapters devoted to Galvani and to Volta call for little comment. That on Coulomb gives a better biography than is accessible in English elsewhere. Those on Oersted, Ampère and Ohm are each good in their way; but that on Ohm lacks proportion. One might think that the whole of mathematical physics began and ended with Ohm's "Law."

The lives of Faraday, Clerk Maxwell, and Lord Kelvin are compiled with a knowledge and sympathetic comprehension. The one phrase to which one must take exception in the account of Lord Kelvin is the suggestion—*apropos* of Lord Kelvin's saying at his jubilee that the most strenuous of his efforts for the advancement of science had ended in "failure"—that "because Dame Nature did not open to his

sesame, but persisted in her reticence, the philosopher grew pessimistic and disappointed." "Pessimistic" is the very last adjective to be applied to Lord Kelvin in his cheery and undaunted battling to the last with the deepest problem of mathematical physics. No trace of disappointment soured the serene close of his strenuous life.

There are eight portraits and a score of illustrative cuts in the work, which is well and clearly printed.

OUR BOOK SHELF.

Syllabus of the Lessons on Marine Biology for Fishermen, given at the Marine Laboratory, Piel, Barrow-in-Furness, by the Lancashire and Western Sea-Fisheries Joint Committee. Revised January, 1910. Pp. 35; 7 plates. (Liverpool: C. Tinling and Co., Ltd., 1910.)

THIS handbook, which has been prepared by Mr. James Johnstone, is written in a clear, direct style, and is illustrated by good text-figures and seven excellent plates. The author is to be especially congratulated on the skill with which he has, throughout the book, avoided the use of technical terms without sacrificing scientific accuracy. The desire to avoid the use of the word protoplasm has, however, led to the use of another term in an unusual sense; on p. 13 the author, dealing with Peridinians, writes:—"They, like the diatoms, are jelly-fish, and have shells . . . ." It would be better to avoid the use of the term jelly-fish, in such a connection, in view of its more generally accepted application to organisms of a higher class.

The book contains outlines of lessons on those branches of marine biology which are of special interest to fishermen—the general anatomy, physiology and development of the mussel, the structure of the cockle, the food of these molluscs; the structure of shrimps, crabs and lobsters, their growth, "casting" (ecdysis) and reproduction; the anatomy of the haddock or whiting, the fecundity of various fishes, especially of flat fishes, that of the flounder being studied in detail; the food in the sea, plankton; the different kinds of spawn found on the shore; the elementary chemistry of air and water, the temperature of the sea, &c. This list will serve to show the range of subjects comprised in this admirably planned course of scientific instruction. The book is certain to stimulate the interest, not only of those who attend the classes, but also of other fishermen, to whose notice it will be brought by their more fortunate fellow-workers who have passed through the classes and used the book.

The Sun a Habitable Body like the Earth. By Sree Benoybhushan Raha Dass. Pp. xiv+130. (Naldha: Published by the Author, 1909.) Price 5s., or 3 rupees.

THIS is, typically, a book "published (and distributed) by the author," and perhaps the kindest statement to make about it is that it is an anachronism. Apparently the author attempts to explain all solar phenomena as electrical effects, and, as a prelude, describes the actions of, and discharges from, insulated conductors; but the language is so often obscure, and, where intelligible, is so devoid of connected reasoning, that no clear idea can be obtained as to the ultimate conclusions. Quotations from great authorities, including Herschel's conclusion as to the sun's habitability, give the volume itself an air of authority which is rudely dispelled on a closer acquaintance.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The "Reindeer" from the Lorthet Grotto.

I HAVE just been consulting in *Science Progress* for July, 1909, the very interesting paper of Prof. Sollas on the Palæolithic races, and I venture to direct attention to the title of an illustration on p. 25. It is entitled "Reindeer and Salmon Incised on a Piece of Horn from Lorthet." This legend is taken from the original figure by the late M. Piette in *L'Anthropologie*, 1904, p. 160; but is the Cervus there engraved rightly ascribed to *tarandus*? Is it not *megaceros*? *Tarandus* has no brow tines like those delineated on this horn plaque. They are more or less palmated, while in *megaceros* they are differently directed, present a different section, and are bifid as are those figured in *Science Progress*. It may or may not be now or later of importance to ascribe correctly this particular drawing, but the determination of the species in prehistoric cave-engravings has an important bearing on the age and climate of the horizon from which they come.

May I venture, if Prof. Sollas will allow me, to refer also to p. 26 of the same important contribution, where occur the words ". . . Saiga antelope, the same animal as that which is sculptured in so masterly a manner on the spear-thrower mentioned on p. 20 (Fig. 3)." The animal sculptured—also after M. Piette's figure in *L'Anthropologie*—on the implement (from Mas d'Azil) referred to can hardly be a *Saiga*. The position and form of the nostrils and the uninflated nose-sac which the side-view reveals preclude this determination. The creature must be a goat or a chamois, or belong to a nearly related genus.

HENRY O. FORBES.

The Museums, Liverpool, March 20.

Centre of Gravity of Annual Rainfall.

THE ordinary method of exhibiting the annual distribution of rainfall for any station or country is a graph the ordinates of which represent the monthly rainfall. Though this pictorial method is both useful and interesting, it does not lend itself to the ready comparison of a number of such graphs for different places or for the same place in different years. By a similar graphic method we can exhibit the yearly rainfall totals for a number of years, but we cannot show differences of internal distribution for each year unless we are at the trouble to graph each month of each year separately.

Another method, which may be called the analytical method, I have been applying recently to the study of the rainfall of the province of Mysore, India, upon which I had to report officially from 1893 to 1908, and I have been much surprised at the results brought out by this method. The same method applied to the rainfall statistics of England, Scotland, and Ireland, as given by Dr. H. R. Mill in "British Rainfall" for 1908, shows also curious and interesting results.

The method consists in the application of the well-known formula for finding the position of the centre of gravity of a number of weights placed along a straight rod, viz. $X = \Sigma(wx) \div \Sigma(w)$. If we imagine the rainfall for the months of the year January, February, . . ., December to be weights placed along an axis at distances 1, 2 . . . 12 units from the Origin, or end of the axis (January 1), multiply each month's rainfall by its distance from the Origin, and divide the sum of the products by the total rainfall for the year, we get the position (or date) at which the year's rainfall might be supposed to have fallen all together to give the same effect as the separate monthly falls.

The Mysore Province, which has about the same area as Scotland without the Isles (28,000 square miles), is divided into eight *Districts*, which differ greatly in the amount of yearly rainfall, as well as in the monthly distribution. Each *District* is divided into a number of

parishes, called *Taluks*, and the rainfall is gauged at the chief town of each Taluk. The mean of these is taken as the rainfall for each District. From the average monthly rainfall of each District for the past thirty-nine years I have found the C.G., also for the year 1908, and they are given for comparison:—

District.	No. of Taluks.	Average for 39 years. Rainfall	C.G.	1908. Rainfall.	C.G.
1. Bangalore ...	10	30·48	7·93	25·49	6·47
2. Mysore ...	13	27·53	7·74	24·24	6·64
3. Hassan ...	8	37·95	7·62	27·98	6·74
4. Chitaldrug...	9	21·10	7·51	14·03	6·93
5. Tumkur...	10	25·90	8·01	15·76	7·00
6. Kolar ...	11	27·89	8·14	16·00	7·07
7. Shimoga ...	9	66·60	7·34	67·31	7·14
8. Kadur ...	7	73·00	7·40	63·74	7·06
Province ...	77	36·79	7·68	29·94	6·91

The Shimoga and Kadur districts each include three stations where the rainfall is enormously greater than at the other stations; yet though the thirty-nine-years' average annual rainfall for six of the Shimoga Taluk stations is only 35·78 inches, and for the three stations of great rainfall it is 128·24 inches, I find that the mean position of the C.G. is 7·28 for these three stations, while for the whole nine stations it is 7·34. In the same Shimoga District there are, besides the nine Taluk stations, fourteen additional rain-gauge stations, among which are Agumbi, with a mean yearly rainfall of 333·17 inches, Aralagode, with mean of 237·79 inches, and Karur, with mean of 115·79 inches, and I find the C.G. for these is at 7·29, 7·21, and 7·13 respectively.

It is to be noted that the great deficiency of rainfall throughout Mysore Province as a whole for the year 1908 is indicated, not only by the diminished yearly totals, but by the displacements of the C.G. for each District and for the whole Province. This means, of course, that the deficiency was in the "latter rains"—or those for the north-east monsoon—but the important thing is that we have a simple numerical measure, by combining the displacement of the C.G. and the total rainfall defect, of the real rainfall deficiency for the year. Thus while the rainfall average for the whole Province was 18·6 per cent. less than the yearly normal, the deficiency of the *rain-moment*, as we may call it in the language of mechanics, was 26·8 per cent., which agrees better with the agricultural effect.

This has led me to examine Dr. H. R. Mill's "British Rainfall" for 1908, and the results of working out the C.G. for a large number of stations, and for the 1908 mean rainfall of England, Scotland, and Ireland, are interesting. The position of the C.G. for the monthly mean rainfall of 122 stations in England and Wales is 6·54, of 55 stations in Scotland 6·37, of 53 stations in Ireland 6·72, and of 230 stations in the whole British Isles 6·55. For Greenwich, with rainfall 23·78 inches, it is 6·48; for Borrowdale (Cumberland), with rainfall of 127·38 inches, it is 6·54; for Glenquoich (Inverness), with 107·40 inches, it is 6·21; for Kenmare (Co. Kerry), with 70·91 inches, it is 6·59.

From the Journal of the Scottish Meteorological Society for 1908 I find the following results:—

	Year's Rainfall.	C.G.
Means of the eight principal towns of Scotland	33·05	6·54
Means for all Scotland for 1908	37·55	6·48
Means for all Scotland for fifty years (1856–1905)	39·19	6·87
Means for 1908 of eighteen Lighthouses on the Scottish coast	30·74	6·68

It is remarkable that the rainfall should be so small at the Lighthouses, and that the law of rain-distribution throughout the year should agree with that for the land-stations. The smallest rainfall for 1908 was at the Isle of May Lighthouse, where it was only 18·33 inches, with C.G. at 6·90; and the heaviest rainfall was at Ardnamurchan Lighthouse, where it was 50·99 inches, with C.G. at 6·63.

This method is readily applicable to the graphic presentation for a series of years either of the C.G. or of the *rain-moment*. Thus I have worked out the results for Bangalore from 1867 to 1908, and find that while the average position of the C.G. is 7·81, the positions for 1875 and 1876, the successive droughts of which caused the great Mysore famine, were 6·82 and 6·72, and while the average *rain-moment* is 276, it was for those years only 151 and 117 respectively. I also find that for the two years 1907 and 1908 the C.G. for Bangalore was at 6·77 and 6·08 respectively, and that the rain-moments were 214 and 157; which agree with the fact that Mysore narrowly escaped another serious famine quite recently, and give a measure of the margin by which it escaped the disaster caused by the rain deficiency of 1875 and 1876.

It is evident that we might easily graph on the same sheet for a sequence of years (1) the total rainfall; (2) its yearly C.G.; and (3) its rain-moment or coefficient. This principle will also give the data for charts of the general distribution of rainfall in a country for any year or series of years. That each station and country has its rain-constant which can be expressed numerically seems to be more than a mere theoretical curiosity.

J. COOK.

30 Hermitage Gardens, Edinburgh.

Lycopodium Spores.

MISS EDITH A. STONEY states (NATURE, January 6, vol. lxxxii., p. 279) that with a large aperture microscope objective and oblique illumination, Lycopodium spores are seen to be coated with hair-like projections. We believe this appearance to be illusory. Owing to the transparency of the outermost layer of cells, the margin of the spore is quite invisible under certain conditions, giving to the radial cell walls the appearance of hair-like projections.

Photomicrographs of some of these spores reproduced in the *Physikalische Zeitschrift* of February 1, p. 78, show the effect in question in some parts of the field, and evidence the correctness of the explanation given.

JOHN ZELENY.
L. W. MCKEEHAN.

Dr. H. J. Hansen and the Copenhagen Museum of Zoology.

I BEG permission to acknowledge the receipt of the open letter sent me through your Journal of March 10, by the leading zoologists of Great Britain and Ireland, regarding my resignation from the Copenhagen Museum and my zoological investigations. I am deeply conscious of the great honour done me in sending me such an address, and I regret that I am unable to write to all personally; but for that reason I would request them through your columns to accept my most sincere and heartfelt thanks.

H. J. HANSEN.

5te Juni Plads No. 1, Kjóbenhavn, F., March 17.

Title of the Natural History Museum.

WHAT has history, in its present sense, to do with the subject? What have the Muses to do with it? Certainly Terpsichore is not included at any of the museums. The N.H.M.(B.M.) is not a museum, but a Natureum. Might not a ten-syllable name on the other side of the way be replaced by the Arteum? Then Bloomsbury might use the name Historeum. The address need not include London or England, as no other place uses these terms. For all scientific reference one word would be complete.

W. M. F. P.

The Meaning of Ionisation.

IN his lecture at the Royal Institution on March 11, Dr. Brereton Baker proposed the term electromerisation instead of ionisation when applied to gases. May I venture to suggest the word "electronisation" as more euphonious, and as indicating the essential difference in the process, viz. the freeing of electrons instead of ions?

W. DEANE BUTCHER.

Holyrood, Ealing, March 18.

NUMERALISED PROFILES FOR CLASSIFICATION AND RECOGNITION.

WHEN children or savages attempt to draw a human profile, the result is usually a rude figure that lays stress on five cardinal points. These are the notch between the brow and the nose, the tip of the nose, the notch between the nose and the upper lip, the parting of the lips, and the tip of the chin. Supposing these five points, B′, N′, U′, L′, and C′, to be located with fair precision, as will shortly be shown to be feasible, then Fig. 1 is directly deducible from them, together with the vertical and horizontal axes, C′B′, and C′X at right angles to C′B′. The position of the five cardinal points varies in different profiles much more than the probable error of measurement. So though Fig. 1 is a mere skeleton, which determines what may be called the set of the features, and corresponds to the primary triangulation of a country, other points are to be derived from it, and similarly utilised. Among these are the intersections with the outline by perpendiculars, drawn from the middle or other specified division of the lines. This skeleton serves as an excellent basis for the classification of profiles and for anthropological statistics.

Peculiarities of profile, as a racial or family characteristic, can be expressed numerically by an extension of this system in a way that promises to be serviceable for eugenic records. It was, in fact, largely with this object in view that I began the

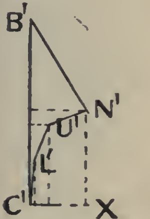


FIG. I

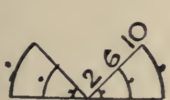


FIG. 2

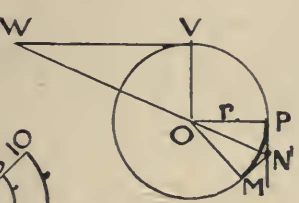


FIG. 3

inquiry. The replacement in all scientific work by numerical values, in the place of vague adjectives, is a gain of first-class importance. There is no way known to me, other than this, by which likenesses can be "lexiconised," that is, arranged as words in a dictionary. A needed portrait may by its means be discovered by a formula, as a spoken word is found in a dictionary, by the letters that express its sound. There are many simple purposes of newspaper interest to which this same method might be applied, but with more elaboration.

The practice of cataloguing profiles may perhaps become useful as a secondary means of identification when the number of persons who may require to be identified shall have become too large to be readily dealt with by finger-prints alone.

It will be shown (Fig. 5) that four telegraphic "words" are sufficient to convey a very fair profile likeness. The cost of sending an extra four words by telegram to any part of the British Isles being only twopence, and of a moderate amount over-seas, the practice of telegraphing profiles of persons of current interest, might become common. A refugee criminal could easily be outstripped by his portrait, sufficiently like to him to justify, in connection with corroborative evidence, his being placed for a while under police observation. The measures of profiles must, of course, be reduced to uniformity. Thus, by utilising two out of the five cardinal points to give direction and scale, the mean positions of the remaining three points may be determined for any given race or family, together with the frequency of deviations of any given amount from those mean positions, and such other deductions as can be reached by the modern methods of statistics.

The corrected values are here described by the same letters as the original ones, but without the dashes. The standard scale that is used is such that BC, the corrected value of B′C′, shall be always 50 units in length (see Fig. 5). The reduction is, of course, effected by multiplying each measure in the portrait by 50 divided by its B′C′. The number 50 is preferable to 100, which would probably first suggest itself, for a variety of practical reasons, into which I need not now enter. Two figures are assigned to each measure, so the values 0, 1, 2, -.9, have to be written 00, 01, 02, .09. The measures are recorded to the nearest integer, there being no room for fractions, decimal or other. A millimetre is a convenient unit for purposes of drawing, more so than one-tenth of an inch; therefore, in reproducing the corrected measures, BC becomes 50 millimetres, and the other measures are altered in the same proportion.

A thick beard interferes with determining L′ and U′, but their positions can usually be inferred with a useful degree of precision in moderately bearded faces.

The accuracy with which the five cardinal points can be located differs considerably. The most exact determinations in an unbearded face are those of the points C′ and N′, and the direction of the line C′B′. U′ comes next in order of exactness, then B′, and, lastly, L′. The distance between a line joining C′N′ and a parallel line tangential to U′, can be fixed with precision but is not used here. C′ and N′ are each defined by the intersection of two tangents, as shown for N′ in Fig. 3.

It is well to examine these conditions more closely, as they bear on the treatment of curvatures generally. A knowledge of them permits rough and ready drawing, in which the principal matters are attended to, the less essential ones being more or less disregarded. One of the tangents is parallel to C′B′, which is treated as vertical; the other is inclined to the vertical at 45°. Consequently, the curve of N′ is contained in an obtuse angle of $180° - 45° = 135°$. The tip of each prominence and the bottom of each hollow is represented by one or other of the three short circular arcs shown in Fig. 2, which are sufficiently numerous for the purposes to which they are here applied. The centres of all circles that touch both the vertical and the diagonal will necessarily lie in the line that bisects the obtuse angle between them; consequently, N′O forms an angle with the vertical that is equal to half 135°, or $67\frac{1}{2}°$. The tangent of this angle is 2·4142; therefore the position of the line of centres may be found by laying off a point V in a vertical direction, at 10 units of length from O, and by drawing another line from V horizontally to W, at a distance from it equal to 24·14 of the same units as before. Then the line of centres passes through O and W. It is easily shown (Fig. 3) that the points of contact between the circle and the two tangents are exactly 45° of arc apart. The length of the chord of that angle is equal to about three-quarters of its radius. The shortness of the chord, when the radius is small, is well seen in Fig. 2, and must be borne in mind; it accounts for the scarcely noticeable differences in the curvatures, and consequently for the fewness of the standard arcs that are necessary. The arc of 45° is shown by a heavy line in Fig. 3, where the circle has a radius of 10 mm. There is often a colloquial confusion between the obliquity of the planes between which an edge lies and that of the sides of the edge itself. The former may be very acute, and the angle of the edge would be equally acute if the planes were prolonged until they met; but usually they do not meet, the edge itself being more or less rounded. The acutely inclined faces of a knife may have a blunted edge, that fails to cut the skin without much pressure, while a broken piece of glass, the fracture

of which is perpendicular to its face, but the edge of which is not blunted, only too readily makes a gash.

The arcs of 45° in Fig. 2 all refer to the cutting edge, so to speak. The direction of the lines within which the cutting edge is situated is determined by the adjacent cardinal points towards which they point.

Referring back to Fig. 3, $OP=OM=r$, the radius, $ON=r\times 1{\cdot}082$, therefore the distance between N and the circle is only $r\times 0{\cdot}82$, which for a radius = 10 mm. is about three-quarters of 1 mm. This small value is diminished in proportion for lesser values of r (see Fig. 2), so for practical purposes N (and similarly C) may be considered to lie only just outside the convex circumference of the arc by which they are in each case represented.

The values of r which are used as standards for the lesser curvatures are 2 mm., 6 mm., and 10 mm. The drawings in Fig. 4 are not exactly on this scale, but the differences are unimportant. It is unnecessary to divide these small curves into concave and convex, as their condition in that respect is indicated by the part they play in the profile. Two other curvatures of the larger radii, 25 mm. and 30 mm., are used to express and to define the concavity or the convexity of the ridge of the nose.

formulæ. Twenty figures enter into each formula; they are arranged, as for telegraphy, in the way already described, into four groups of five figures in each group. A "figure," in telegraphic language, includes not only the ten numerals, 0 to 9, but the three symbols in addition, of a stop (.), a hyphen (-), and a short oblique line (/), such as is used in fractions. The arrangement in groups of five, or in "quintets," proved suitable to other similar work on which I was engaged, so it has been adopted throughout. In the four quintets, or, we may say, in the four *words* that compose a formula, the first three refer respectively to N, U and L, and in that order. The first two and the last two figures, in each of the first three quintets, give the position of the point in question in X and in Y to the nearest whole millimetre. The middle figure of the quintet is derived from Fig. 4 to describe the peculiarities of the profile at and immediately adjacent to that point. The fourth and last of the quintets is preceded by a dot (.), to show that it belongs to a separate category,

It is well, at the risk of some repetition, to describe in a single paragraph the nomenclature of the five cardinal points in the original portrait. B′ is the point in the fronto-nasal notch at what is judged to be its deepest part; N′ is the tip of the nose, found in the way already described; U′ is the point of contact between the naso-labial notch and a tangent, drawn diagonally to it; L′ is a point half-way between the furthest positions at which the lips would touch one another if they were lightly closed; C′ is found by a similar method to that used for N′.

The portraits are described by numerical formulæ. Each formula consists of four groups of figures, five figures in each group. The shapes of the profile at and immediately adjacent to the cardinal points, and those of the intermediate links, are expressed by single numerals, as set forth in tabular form in Fig. 4. Not more than 0 to 9, or 10, varieties of shape are provided in each case. Thus, the radius of the standard curve that best fits the fronto-nasal notch, *b*, is expressed by its appropriate numeral, as shown in the first line of Fig. 4; also the inclination of the brow immediately above *b*, whether it slopes forwards, backwards, or is upright. The ridge of the nose *g* is counted as either sinuous, concave, or convex, in two or three different degrees, or else as straight. The letter *n* includes both the very tip of the nose and the outline underneath it, which leads towards the naso-labial notch. The letter *u* includes the naso-labial notch and the first portion of the upper lip. The lips require two statements, and therefore two separate figures; the former, *lp*, shows whether the lips are shut, parted in the portrait by 1 or 2 mm., or open by 3 mm. or more, and, again, whether they project evenly, are overhung or underhung. The latter notation, *ll*, expresses the sizes of the upper and lower lips respectively, whether they are small, medium, or large. The outline between the lower lip and the chin is always notched, and *k* describes the size and position of the notch, whether it be small, medium, or large, and whether it be high, medium, or low. The curve of the chin itself at C′ is not given.

FIG. 4.

I have called these profiles "numeralised" to express the fact that they are transformed into numerical

namely, to the peculiarities of *b*, *g*, *ll*, and *k*, as set forth in Fig. 4, and in that order. When proceeding to draw a figure from a formula, it is advisable for a beginner to use tracing paper. Then, after drawing an arbitrary line in any convenient place, of 50 millimetres in length, to serve for BC and, therefore, for the vertical axis, and another line CX, at right angles to CB at C, for the horizontal axis, to plot the positions of N, U, and L; then, laying the transparent paper upon Fig. 4, to trace, or copy on an enlarged or reduced form, according to the space available, the figures of *n*, *u*, and *lp*, very faintly. Next to do the same to *b*, *g*, *ll*, and *k*. Afterwards to harmonise the whole tentatively, with faint and brush-like strokes; lastly, with a free and firm hand to draw the outline through them. Tracing paper may otherwise be convenient, because when the original profile looks to the left, by the simple act of turning the traced outline it affords an almost equally clear profile, looking to the right.

When transforming the portrait into a formula, the reverse process has to be followed with little alteration. Before finally adopting any formula, the portrait should be reconstructed from it and the formula revised where necessary. It is easy after a little practice mentally to compose a formula so far as the seven small letters are concerned, from a brief inspection, either of the picture or of the living face; also to reproduce by copying by eye the symbols from Fig. 4 without caring to trace them. In short, the whole operation may be satisfactorily gone through by an intelligent person in a rapid and off-hand way. This might become a popular game for the members of a party to practise their art upon one another, care being taken that the five cardinal points should be truly laid down, perhaps by tracing a shadow.

Eight couplets of very different features are given in Fig. 5, both for illustration and for the reader to practise upon. Each couplet contains the original portrait on the left, its formula along the bottom, and the reproduction from the formula (to the standard scale) on the right.

It will be seen from Fig. 5 that four-word portraits are by no means deficient in resemblance to their originals. I think they are considerably more like to them than the sketches, usually printed in the illustrated newspapers, are to the public characters whom they profess to represent. They are, to say the least, of considerable negative value, sufficing to eliminate at the rate of about nineteen out of every twenty individuals as *not* being the person referred to.

Any form of telegraphy suffices to transmit these four-word profiles. In other respects they are far inferior to those complete pictures now transmitted between certain offices, by means of costly and delicate apparatus, by a method at present not developed to its utmost.

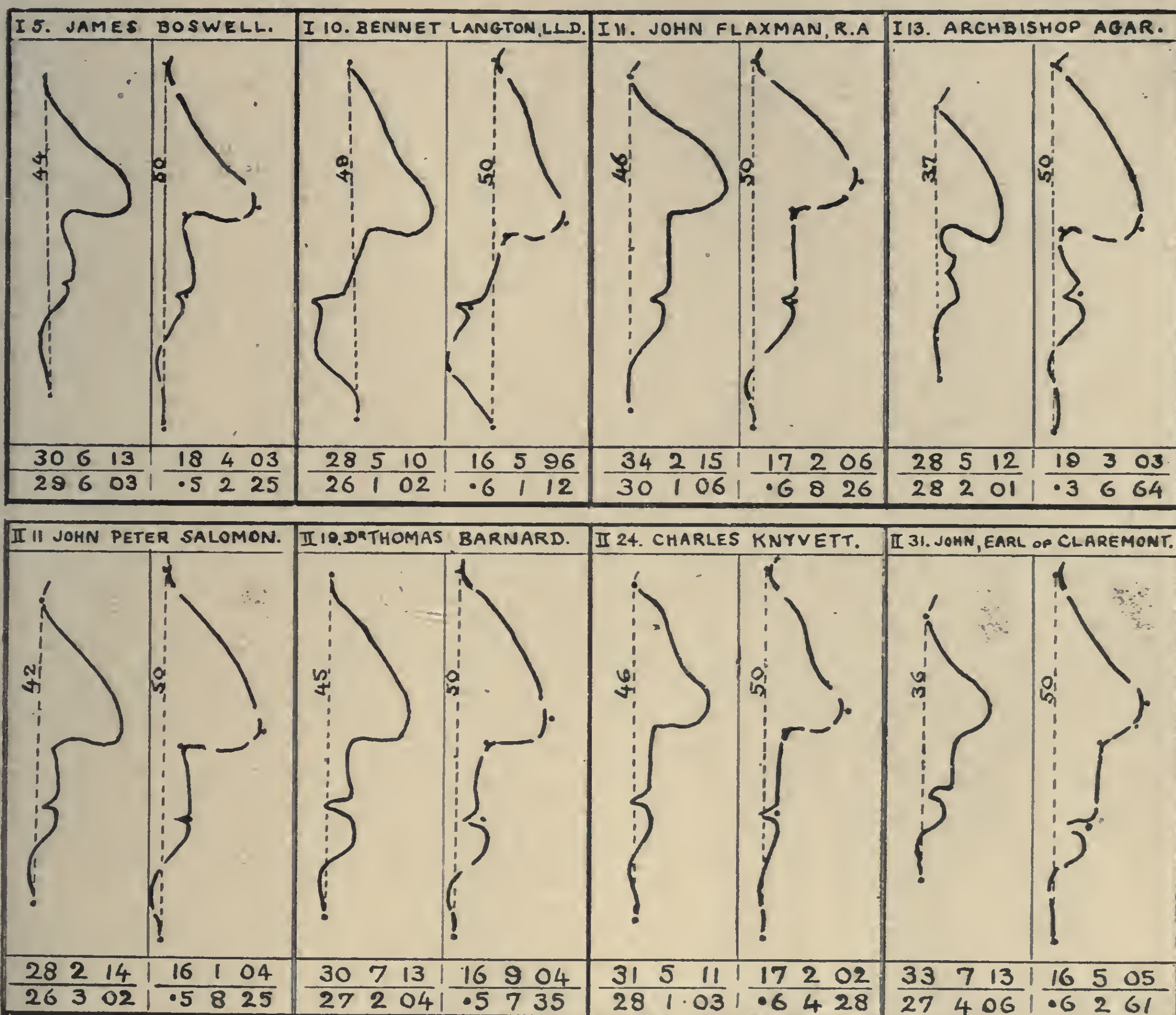


FIG. 5.

Explanation of the first formula, namely, that of James Boswell; the others are to be read on the same principle. N_x, 30; N_y, 13. U_x, 28; U_y, 03. L_x, 18; L_y, 03. The small letters are, *n*, 6; *u*, 6; *lp*, 4. *b*, 5; *g*, 2; *ll*, 2; *k*, 5.

It will be observed that in the second of the portraits, namely, that of Dr. Bennet Langton, the point L lies to the left of CY, and has therefore a negative value. This is −04, but is expressed here as 96, an artifice which practically transfers the horizontal measurement from CY to another vertical line drawn parallel to CY and 100 mm. to its left. No confusion need arise through this transformation, since it leads to very large values lying adjacent to

very small ones, and therefore showing that they belong to a different category. The *minus* values in Y are similarly treated. The process may also be extended beyond the eight squares of 0 to 100 mm. in their sides, that surround the primary one.

My experiments have been chiefly made upon the "Collection of Portraits by George Dance, R.A., Sketched from Life and Engraved in Imitation of the Original Drawings" (Longmans and Co., 1809). They were convenient to work with, being all drawn on scales differing little from that of the standard. All the portraits are unbearded and in exact profile, with three or four exceptions. Those that are available are sixty-eight in number. The name of the person to whom each of the eight portraits in Fig. 5 applies is written along its top, and the volume and page of the two folios by Dance, from which the original was traced, are given in the upper left-hand corners. There are several notabilities in his collection besides those in Fig. 5. Among them are Horace Walpole, General Paoli, Haydn, and John Philip Kemble. An exhibition of Dance's pictures was recently held in London. He had a considerable reputation in his time as a portrait painter.

Methods have been used to aid the recollection of dates and other figures. That by Gray, in his "Memoria Technica," was to transform each numeral into either a consonant or into a vowel or diphthong, as might be the most convenient, and thereby to build up words easy to pronounce and to remember. Those who are familiar with such a process might apply it here, and convert the four quintets of numerals into four words, getting over the difficulty of employing the three additional symbols as best they can. If they succeed, the phrase of "four-word profiles" would be literally exact.

I do not find that a general resemblance can be much increased by using one or a *few* more quintets or words. A fifth, or even a sixth, quintet might, however, be usefully employed in extending the range of the profile, if it contained one figure to describe the chin and just below it, another to describe the brow, and two figures, 00 to 99, which would perhaps suffice to give the size and general shape of the head, also to define the mustachio and beard of unshaven faces.

The next distinct stage in order of accuracy is separated by a great distance from the present one. It requires so large a number of dots that straight or slightly curved lines drawn through them will flow smoothly when seen at the ordinary reading distance from the eye. It needs as many as perhaps fifty quintets to describe a profile with exactness and the rest of the head with rough precision, and still more to include the eye and ear. I have made many of these, which, when reduced to the standard scale of BC = 50 mm., are practically identical with the originals, when viewed in a somewhat careless way by a normally sighted person at a distance of 12 inches. A special use is made in this case of the middle figure of the quintet. Thus, the numeral 1 means that a half-unit is to be added to the first two figures; 2, that it is to be added to the last two; and 3, that it is to be added to both of them. This power of doubly minute description is often wanted in the outline that joins and includes the nose-tip and the two lips. Another use for the middle figure of the quintet is to tell that a dotted line should be drawn from the preceding point, to signify doubt of some kind. A hyphen (-) in the middle of the quintet means to begin; an oblique line (/) to end; and a point (.) means an isolated point. But I will not go further into this now; neither will I do more than hint at the way of dealing with portraits that are not in exact profile, by multiplying their horizontal measures into the secant of the angle through which the profiles are turned away from it.

Much more might be added on extensions of this method, especially as regards its facilities and limitations in conveying plans—ceremonial, strategic, and others—for newspaper use. But its general principles have been explained, and as this article is already too long I will end it abruptly here.

FRANCIS GALTON.

TIDAL OBSERVATIONS IN THE ENGLISH CHANNEL AND NORTH SEA.

FOR the purpose of tracing correctly the progress of the tidal wave throughout its course in the English Channel and North Sea, observations of the vertical movement of the tide at a distance from the land, and similar observations by means of tide gauges on the shore, are equally necessary.

Information on the rise and fall of tide far from the shore may be obtained from a ship or boat at anchor, and in certain localities it may be of considerable value to the navigator.

But, if the observations are carried out with sufficient exactitude to satisfy scientific requirements, the procedure hitherto followed for that purpose necessitates weather conditions which do not often occur, and seldom last long enough for the object in view.

There are other difficulties also to contend with, due to the stream of tide running at its maximum rate at, or about, the times of high and low water. The stream, reversing its direction between those times, causes a mark buoy, or boat, however, tautly moored, to swing over a certain area during the interval; the undulating character of the surface of the ground, and the action of the strong tidal stream on the lead-line, thus tend to introduce elements of uncertainty which increase with the depth of water.

The practical difficulties experienced in obtaining strictly accurate results by this means involve loss of time disproportionate to the value of the observations, and therefore the attempt has not often been made.

Trustworthy evidence on the rise and fall of tide is thus almost entirely confined to the coast-line, with the exception of a few observations of tide-gauges attached to the masts of wrecks on off-lying banks in the North Sea.

A large number of observations of value for the reduction of soundings have, however, been obtained in the North Sea during the years 1886–90 by Captain T. H. Tizard, R.N., C.B., F.R.S., while commanding H.M.S. *Triton* in the course of the survey of the shoals fronting the Norfolk coast. These, being taken by the lead-line from the ship at anchor, on the assumption that the bottom was perfectly level, can scarcely be considered sufficiently trustworthy for scientific purposes until confirmed by more precise methods which were not then available.

More rigorous observations were carried out in the North Sea by the late Captain W. Hewett, R.N., commanding H.M. surveying ship *Fairy* in 1838 and 1840, with the object of verifying the prediction of the late Dr. Whewell as to the existence of an area situated eastward of Orfordness and about midway between the coasts of England and Holland, where the rise and fall of tide was expected to vanish.

The method employed by Captain Hewett was to moor a boat head and stern as tautly as possible by means of lead-lines attached to anchors laid out in the direction of the tidal streams. A remarkable elevation in the form of a ridge on the bottom, with a depth of $18\frac{1}{2}$ fathoms over it, having been previously detected, the boat was moored at slack water as nearly as possible directly over the ridge. Another boat dropping down with the tide, with lead kept just on and

off the bottom, the summit of the ridge was felt with the lead, and the depth over it registered every half-hour from 5.30 a.m. to 8 p.m., August 25, 1840.

The observations, being carried out with the utmost care under exceptionally favourable conditions of weather, gave an absolutely uniform depth throughout the day, showing conclusively that at that spot there was no rise and fall of tide. The position in which the observations were made was in lat. 52° 27′ 30″ N., long. 3° 11′ 30″ E., the moon's age being 27·6 days, and the maximum strength of the tidal stream 1·6 knots.

The particular spot for observation, as indicated by Dr. Whewell, was about 30 miles S.S.W. (true) from the above position, but circumstances did not permit of reaching it, and no observations have yet been made there.

On a former occasion, on July 5, 1838, the moon's age being 13·4 days, at a position about 20 miles S.S.E. (true) from Dr. Whewell's position, using precisely the same method and under conditions only slightly less favourable, Captain Hewett found a rise and fall of tide of 6½ feet.

The question of tidal observations in deep water having recently engaged attention at the Hydrographic Department of the Admiralty, an apparatus has been devised which obviates to a great extent the difficulties referred to above.

This apparatus, for use from a ship at anchor, is based on a principle similar to that of the pneumatic self-recording tide gauge now under trial by the Admiralty. It consists of india-rubber tubing having a bore of about ⅛ inch, supplied in a sufficient number of lengths joined together to allow one end open to the sea to be attached to a weight lowered to the bottom near the anchor. The inboard end of the tubing is attached to the upper part of a closed vertical cylinder 4 inches in diameter and about 6 feet high, on the top of which is fitted a small Bourdon gauge of ordinary pattern. The lower part of the vertical cylinder is in connection with an air-reservoir, and is also connected, by a separate pipe of small diameter, with a large Bourdon gauge of special construction.

The air-reservoir, charged by a powerful air pump, consists of four cylinders, each of which is similar in size and pattern to the vertical cylinder. The large Bourdon gauge is 12 inches in diameter, very delicately made, capable of indicating pressures up to 250 lb. on the square inch, and graduated on a reflecting surface to obviate the effect of parallax in reading off. It can be accurately read to within 1/10 lb.

The method of using the apparatus is as follows:—With the ship lying at anchor, and having sufficient cable veered, the india-rubber tubing should bear no strain. The 12-inch Bourdon gauge being shut off by a needle-valve controlling connection with the remainder of the apparatus, air is pumped into the air-reservoir, flowing from thence to the sea through the vertical cylinder and india-rubber tubing. Pumping is continued until the small Bourdon gauge ceases to rise, thereby showing that all the water is expelled from the tubing, and that the air is escaping freely from the submerged end, at each stroke of the pump. The valve at the junction of the india-rubber tubing and vertical cylinder, controlling connection with the sea, is then closed, and the air reservoir and vertical cylinder charged to a pressure considerably exceeding that of the head of water due to the depth. The compressed air being then admitted to the 12-inch Bourdon gauge by turning the needle-valve, the whole apparatus is again placed in direct communication with the sea by means of the valve for that purpose.

The air pressure as shown by the 12-inch Bourdon gauge will then steadily fall as the air escapes into the sea, and will continue to do so until the pressure in the apparatus exactly balances that due to the column of water represented by the depth over the submerged end of the india-rubber tubing. When the pointer of the 12-inch gauge ceases to fall and remains quite stationary, the gauge is read off.

As a column of sea water 1 foot high, with sectional area of 1 square inch, weighs 0·445 lb., it follows that the depth is obtained by the multiplication of that factor by the pressure in lbs. per square inch as indicated by the gauge. The variation in pressure, provided the weight at the submerged end of the india-rubber tubing has not moved its position, is therefore a measure of the rise and fall of tide.

Observations with this apparatus have been made successfully in depths of 35 fathoms, and the results, when compared with observations of an ordinary tide-gauge on the beach in the immediate vicinity, were found to agree very closely. For purposes of comparison, simultaneous observations were taken afloat and ashore at half-hourly intervals during several days. In fine weather an occasional difference of 2 or 3 inches might be noted, but it seldom exceeded one inch, or even less.

On one occasion when observations were being made during bad weather, force of wind 5 to 6, with the ship rolling and pitching considerably, difficulty was experienced in reading the gauge accurately; the differences observed were consequently somewhat larger, but in no case exceeded 8 inches. The Bourdon gauge used on that occasion has, however, since been vastly improved by the addition of the reflecting surface for the avoidance of parallax, besides other modifications tending towards greater accuracy and facility in reading off. The improved gauge may be expected to give results on which reliance may confidently be placed within a very small margin of error, even under unfavourable conditions.

The apparatus having been thus satisfactorily tested, the officer commanding H.M. surveying ship *Triton* was directed to make observations at certain positions in the English Channel, using the improved Bourdon gauge, with the view of verifying the co-tidal lines as drawn by the late Dr. Whewell from theoretical considerations.

The results given in the following table are very interesting, and show that the theoretical co-tidal lines require considerable modification. It may be hoped that with an apparatus available which enables accurate observations to be carried out without unnecessary loss of time, further information may eventually be obtained in many parts of the English Channel and North Sea.

A. M. F.

English Channel.—Tidal Observations by Capt. W. P. Dawson, R.N., H.M.S. "Triton," May, 1909.

Date 1909	Position ° ′ ″	Depth Fathoms	Wind	Time of High Water h. m.	Time of preceding Moon's Transit h m.	Lunitidal Interval h. m.	Time of Low Water h. m.	Range of Tide ft. in.	Max. Current knots	Bar. and Ther.	Time of H.W. at Dover h. m.
May 18	50 22 35 N. 0 35 40 E.	24	West 2·3	9 30 a.m.	10 33 p.m. May 17	10 57	4 30 p.m.	24 0	1·5	30·20 / 53	9 40 a.m.
May 19	50 9 30 N. 0 49 15 W.	27	Calm	10 30 a.m.	11 26 p.m. May 18	11 4	4 30 a.m.	13 9	2·6	30·40 / 55	10 30 a.m.
May 20	50 26 0 N. 1 8 0 W.	19	E. b S. 0–1	10 30 a.m.	0 21 a.m. May 20	10 9	4 15 a.m.	10 11	4 0	30·30 / 52	11 24 a.m.
May 21	50 24 10 N. 2 2 10 W.	23	Lt. air W.	8 50 p.m.	1 46 p.m. May 21	7 4	1 0 a.m. May 22	6 6	3·5	30·16 / 55	0 7 p.m.

All times are G.M. Time.

MODERN AËRONAUTICS.[1]

(1) WITHIN about three hundred pages Mr. Turner gives a popular account of the whole field of aërial navigation, including balloons, airships, and aëroplanes, in his survey. He first gives an account of the history and principles of each branch of the subject. In the chapter on the principles of ballooning the expansion of the gas in a balloon appears to be attributed mainly to the heating by the sun's rays, and only a sentence, by the way, refers to the expansion due to the diminished pressure at an increased height, which, of course, affects the gas in the balloon and the surrounding air equally, and also materially affects the vertical stability of the balloon's equilibrium in the air. The natural variation of the temperature of the air with altitude might also be with advantage discussed more fully. In treating of balloons of the non-rigid type, the action of the *ballonet* in preventing flabbiness might be made clearer. On p. 181, after exposing the fallacy of an airship tacking, Mr. Turner seems to say that aëroplanes are on a different footing. Of course, the speed of an aëroplane is relative to the air just as an airship's is, and an aëroplane and an airship capable of travelling at the same speed are under the same conditions as to the directions in which they can travel in a wind. The aëroplane can have the advantage only so far as its speed exceeds the airship's.

FIG. 1.—Scouts: old and new. From "Aërial Navigation of To-day."

The second part of the book deals with various problems which have to be solved. Very interesting speculations are made about the aërial law of the future, and the landmarks, sign-posts, and alighting stations which will be provided for aviators. In chapters on military and naval aëronautics and strategy and aërial invasion, Mr. Turner discusses questions which interest everyone at present. A very clear account is given of the limitations which make some of the achievements that have been attributed to aërial craft impossible, and others improbable of execution, while at the same time full justice is done to the great services they can render within their limitations. Mr. Turner's discussion of these important matters can be recommended as sane and reasonable. Other chapters deal with the possibilities of exploration and long-distance travel in general by the air, and in a chapter headed "Work to be Done" attention is directed, among other things, to the need for increased stability in aëroplanes and for a trustworthy light motor.

While those who wish to construct aëroplanes will have to have recourse to fuller and more technical treatises, this book fills a want, and a second edition is already advertised.

In a couple of places characteristically English remarks are made at the expense of mathematicians and men of science in general. These are the more uncalled for in view of the very hazy notions which the book itself shows up, regarding stability and similar questions, that are capable of exact mathematical treatment, as well as experimental tests. The references to stability alone show a lack of exactness in the use of well-known mathematical and physical terms. Thus in the glossary at the end we have the following definitions:—

"*Equilibrium.*—In flying machines the term is used in the same sense as stability."

"Horizontal stability is the same as longitudinal"; while on p. 291 the author says (of dirigibles):—

"To maintain horizontal stability—that is, to enable the airship to move forward in a straight line without veering to one side or the other—fixed vertical planes at the rear of the frame are used. In addition, there is a fixed vertical plane surface at the rear of the gas-envelope."

The "useful tables" and "glossary" at the end are good features.

(2) Mr. Samuelson's pamphlet, a continuation of a previous publication of the author's, begins with a description and drawings of a model flying machine on the principle of "rowing" flight, and concludes

[1] (1) "Aërial Navigation of To-day. A Popular Account of the Evolution of Aëronautics." By C. C. Turner. Pp. 327. (London: Seeley and Co., Ltd., 1910.) Price 5s. net.
(2) "Flight Velocity." By Arnold Samuelson. (English edition of "Fluggeschwindigkeit.") Pp. 56; 5 plates. (Hamburg: Boysen and Masch; London: E. and F. N. Spon, Ltd., 1906.)
(3) "The Conquest of the Air, or the Advent of Aërial Navigation." By Prof. A. Lawrence Rotch. Pp. x+192; 36 illustrations. (New York: Moffat, Yard and Co., 1909.)
(4) "Aërodynamik: eine Gesamtwerk über das Fliegen." Von F. W. Lanchester; übersetzt von C. und A. Runge. Erster Band. Pp. xiv+360. (Leipzig and Berlin: B. G. Teubner, 1909.) Price 12 marks.

with a proposal to form a company to construct a full-sized machine from the author's plans. The principles on which the author relies are not those generally accepted. He maintains that the centre of pressure for a plane does not vary with its inclination to the line of flight, that the normal pressure is independent of the inclination, and that flapping wings can be constructed so as to be mechanically more efficient than a screw propeller. To establish these principles he seems to rely on rough experiments with kites and small gliders. The accuracy of the observations and he deductions made from them both seem open to question. Plotting v against t, the graph of

$$v=\frac{1}{\frac{n}{M}t+\frac{1}{v_a}}$$

is said to be a straight line, because v and t only appear in the first power. The author maintains that his observations prove Langley's to be inaccurate, and attempts to explain away the discrepancy between his principles and Langley's experiments in a way which is not convincing.

(3) The preface to Mr. Lawrence Rotch's book is dated April, 1909, and when we think of the number of flights performed since then it will be evident that no writer could possibly bring out a book containing the most up-to-date records in aviation. The author has, on the other hand, brought into prominence several aspects of aërial navigation which are apt to be forgotten in these days, when the breaking of records by 'planes (not to mention other breakages of a regrettable character) is the all-absorbing topic. For example, in chapter i., the ocean of air, we have an account of the results of meteorological observations in which the author has played a most important part. It is illustrated by diagrams showing the greatest altitudes reached by mountains, balloons, and *ballons sondes*, also variations of temperature and wind velocity with the altitude, and it well shows up the efficiency of kites and *ballons sondes* in exploring regions of the atmosphere to which man can never hope to penetrate. In the second chapter—the history of aërostation—the author reproduces the letters of Benjamin Franklin to Sir Joseph Banks, P.R.S., describing the first balloon ascents made in France. The following extract from one of these letters is worth reading at the present day:—

"I am sorry this Experiment is totally neglected in England, where mechanical Genius is so strong. I wish I could see the same Emulation between the two nations as I see between the two Parties here. Your Philosophy seems to be too bashful. In this country we are not so much afraid of being laught at. If we do a foolish thing we are the first to laugh at it ourselves, and are almost as much pleased with a *Bon Mot* or *Chanson*, that ridicules well the Disappointment of a Project, as we might have been with its Success. It does not seem to me a good reason to decline prosecuting a new Experiment which apparently increases the power of Man over Matter, till we can see to what Use that Power may be applied. When we have learnt to manage it, we may hope some time or other to find Uses for it, as men have done for Magnetism and Electricity, of which the first Experiments were mere Matters of Amusement."

How true this all sounds to-day! *In England there does not, we believe, exist at the present time a single prize for any scientific investigation bearing on aërial navigation.* Had such a prize existed the theory of longitudinal and lateral stability could have been disposed of years ago, and aëroplanes could have been built with a clear understanding of their stability or lack of it. It should surely have been worth while also for those who spend such large sums on construction of dirigibles to take some steps to obtain a theory of their stability, but this has not been done. There are several other problems, including one or two in discontinuous motion, awaiting solution; and it is not the mathematician alone who is handicapped by the persistent refusal of English people to provide any adequate recognition of *original work*.

We should be greatly surprised if members of the engineering profession would not be glad to make use of a similar encouragement to carry out experiments of rather a more scientific character than would

FIG. 2.—Armoured Defence against Airships. From "Aërial Navigation of To-day."

be otherwise compatible with their business requirements. As it is, there appears to be no such inducement in England for anyone to initiate, undertake, and publish original work, whether on stability, stream lines, propellers, motors, or strength of materials. Indeed, there are very strong inducements for having such work undone, unwritten, and unpublished.[1]

The next two chapters deal, respectively, with the dirigible balloon and the flying machine. In the former we have an illustrated historic description, tracing the gradual progress that has been made in dirigibles since the first idea of one was suggested by Franklin in 1784; while in the latter the evolution of the power-driven machine from the mere glider is briefly but sufficiently well discussed. "The Future of Aërial Navigation" is a subject on which anyone with an imaginative mind can write something which people will read with eagerness, and this being the case, we think that Mr. Rotch has been wise in only devoting twenty pages to it, in preserving the historic order, and in giving numerous references to what has been written. The book is, of course, much smaller and less compendious than Mr. Turner's.

(4) That such English people as are able, in spite of their national disabilities, to undertake *original work* find their efforts appreciated in Germany is well shown by the publication, by the Teubner Press, of a translation of part i. of Mr. Lanchester's book within a comparatively short time of its appearance in England. The English preface is dated October, 1907, the German preface, by Prof. C. Runge, August, 1909, none too long for the work of the translators and printer. We cannot do better now than quote from Prof. C. Runge's German preface in the following terms:—

"The present book contains so many important original ideas and investigations for the development of free flight that German engineers and men of science will be grateful to the publishers for having provided a translation of it.

The author has in some places altered the text, and in others the text has been altered by the translators in consultation with the author, so that the translation may be regarded as a revised edition. A complete retrospect of existing literature was, however, not attempted; this would have altered the character of the whole book and necessitated completely re-writing it, which was not contemplated by the translator.

For men of science the principal charm of the book lies in the ideas on fluid resistance, and the expression of these by exact mathematical formulæ should be the next problem of hydrodynamics."

Does not the last sentence confirm what has been stated above as to the need of prizes for which mathematicians as well as physicists and engineers are eligible?

G. H. Bryan.
E. H. Harper.

[1] Mr. Alexander has offered a prize of 1000*l.* to the Aërial League for the best and most trustworthy motor of 20 h.p. capable of running unattended for twenty-four hours. While fully appreciating the importance and value of such prizes, it should be pointed out that the worker who attempts to penetrate more deeply into the *thermodynamics* or *general theory* of the internal combustion engine, with the view of paving the way for future improvements, has no prospect of reward, whereas the successful competitor for such a prize *may* have other prospects of a return for his exertions in the form of patents.

PROF. K. J. ÅNGSTRÖM.

By the death of Prof. Knut Johan Ångström, physical science has lost a conscientious and capable worker, in a field which requires long and continuous experience before success can be achieved. For this reason his departure will be felt more severely than that of many men, who perhaps have gained a greater reputation, but have been fortunate enough to interest others in the line of research they have been pursuing.

Knut Ångström bore an honoured name. Those who still remember the early days of spectrum analysis know how much that science owed to the pioneer work of his father, Anders Johan Ångström, whose map of the solar spectrum remained until Rowland's time the standard to which all wave-lengths were referred.

The son was born on January 12, 1857, and received his school and university education at Upsala, where he spent almost his entire life. He was appointed assistant in the physical laboratory of that university in 1882, graduated as Doctor of Philosophy in 1885, and became lecturer in physics in the same year. In 1895 he was appointed to the chair of physics, and at the time of his death occupied the position of pro-rector of the university.

So far back as 1889 we find Knut Ångström investigating absorption phenomena in the infra-red by means of the spectro-bolometer, and during the following two years he obtained valuable results on the absorption spectrum of carbonic oxide, carbonic acid, and marsh gas. He also discovered the similarity in the characteristic absorption of the same substances (ether, benzene, bisulphide of carbon) in their liquid and gaseous states.

We owe to him, further, a valuable investigation on the infra-red absorption of aqueous vapour, carbonic acid and ozone. All these gases are constituents of our atmosphere, and the effect of the two latter on the temperature of the earth may be considerable, not so much because they absorb a certain portion of the solar radiation, but chiefly on account of their much greater comparative influence in preventing the heat radiated from the earth from being dissipated into space. An interesting and instructing controversy took place in connection with the effect of carbonic acid. Arrhenius in 1896 had given a very ingenious explanation of the Glacial period by assuming that the quantity of carbonic acid in the atmosphere had increased since that time. If it be assumed that the absorption is proportional to the total quantity present, it can indeed be shown that a small variation in quantity would exercise a very considerable effect on the temperature; but, as pointed out by Knut Ångström, the proportionality between absorption and quantity only holds when the quantities are sufficiently small, and he showed that the quantity of carbonic acid in the atmosphere must be reduced to about 20 per cent. of its present value before an appreciable effect in the total absorption can take place.

In the course of the further discussion of the subject Ångström carried out important observations on the effect of pressure, and showed that by increasing the pressure, but diminishing the thickness of the layer so that the total quantity of absorbing material remains constant, a marked increase of absorption is noticed at the higher pressure. It follows that in order to find by optical means the quantity of carbonic acid in our atmosphere, it is not sufficient to determine the amount of gas necessary in our atmosphere, it is not sufficient to produce the same absorption as shown by the atmosphere, but account must be taken of the conditions of pressure. Observations on the absorption of ozone also led to the interesting result that there must be considerable quantities of that gas in the upper regions of the atmosphere.

Knut Ångström's name has become more particularly associated with recent researches in the measurement of solar radiation. He constructed an instrument, the essential portions of which consist

of two strips of platinum blackened at the front surface and carrying a thermo-junction at the back. One of these is exposed to the radiation to be measured, while an electric current passes through the other. This electric current is regulated until the two thermo-junctions are at the same temperature. The intensity of the current necessary for this purpose gives a measure of the radiation after certain corrections have been applied. The use of the instrument is simple and convenient, and found so much favour with observers well qualified to judge that the International Union of Solar Research recommended it as a standard for measurement of solar radiation.

Since then the instrument has shown itself liable to certain systematic errors which render further experimental investigations necessary. Its intrinsic merit is, however, so great that it is pretty certain that it will re-establish its reputation, but it is much to be regretted that Prof. Ångström's experimental skill is no longer available for the purpose. When the International Union of Solar Research made its recommendation, it was well aware that for a complete determination of the solar constant it is necessary to divide the spectrum into portions sufficiently homogeneous to allow the application of Lambert's law, but such complete determinations need only be carried out in one or two places. Abbot is doing excellent work, and if this be repeated at another station, say in India, the ground will be pretty well covered. In addition to these standards, we require, however, some instrument which is easily transported, and serves to record the radiations received at different times and in different localities. Ångström's pyrheliometer promises to serve that purpose admirably, as soon as more ready means have been found to standardise it easily from time to time, or to obtain a more permanent absorbing surface of the platinum strips. The coloured glasses which Ångström recently used to absorb parts of the spectrum chiefly affecting the absorption of aqueous vapour or carbonic acid will probably increase considerably the utility of the instrument.

It remains to notice an important contribution of Ångström's in the field of radio-activity. He measured, by means of a Bunsen ice calorimeter, the heat set free in a given time by radium salts, and found it to be constant and independent of the substance in which the radium is placed.

Ångström's charming personality endeared him to all with whom he came into contact, and we condole with Swedish science and the University of Upsala in the loss they have sustained. ARTHUR SCHUSTER.

NOTES.

WE notice with great regret the announcement of the death of Prof. Alexander Agassiz, on Monday, at seventy-four years of age.

SIR JAMES DEWAR, F.R.S., has recently received two foreign diplomas, namely, that of Doctor, *honoris causa*, of the University of Brussels, and that of honorary member of the American Chemical Society.

THE Oceanographical Museum at Monaco, established by the Prince of Monaco, was opened on Tuesday by the Prince in the presence of representatives of European Governments and scientific societies. An article upon the museum and the opening ceremony will appear in a later issue of NATURE.

THE third International Physiotherapeutic Congress was opened by President Fallières on Tuesday at the School of Medicine, Paris. A large number of members of the French Government and of the Diplomatic Corps in Paris, including the British and American Ambassadors, were present at the ceremony.

THE council of the South African Association for the Advancement of Science at a recent meeting resolved by a unanimous vote to offer the presidency of the forthcoming meeting in Cape Town to Dr. T. Muir, C.M.G., F.R.S., and he has accepted the invitation to occupy that office. The actual date of the meeting has not yet been fixed.

LORD KINNAIRD will preside at the dinner to Sir John Murray on Tuesday next, April 5, in connection with the *Michael Sars* expedition for the exploration of North Atlantic waters. The dinner will be held at the Criterion Restaurant, and tickets may be obtained from the honorary secretary of the Atlantic Union, 13A Cockspur Street, S.W.

AT a meeting of the National Geographic Society at Washington on March 26, President Taft presented the gold medal of the society to Sir Ernest Shackleton, and in doing so he remarked :—" It is evidence of the society's high appreciation of the marvellous work you have done in the cause of science, of the endurance, courage and intelligence you have shown in the pursuit of a definite object." On March 28 the explorer was presented with the Cullum gold medal of the American Geographical Society, New York.

ON March 23 the Mayor of Doncaster, Councillor Halmshaw, formally opened a municipal museum at Doncaster, for which purpose some of the rooms in a fine mansion, known as Beechfield, have been set apart. These are devoted to specimens illustrating local geology, archæology, and natural history. Mr. T. Sheppard, of Hull, who a short time ago was asked by the Doncaster Corporation to report on the lines the museum should take, was called upon by the Mayor to give an address. In this he dwelt more particularly upon the educational advantages of museums, and the necessity of provincial museums being of local interest. Subsequently the visitors were conducted round the collections, which reflected great credit upon the curator, Dr. Corbett.

ON Tuesday next, April 5, Dr. A. Harden will begin a course of three lectures at the Royal Institution on "The Modern Development of the Problem of Alcoholic Fermentation"; on Thursday, April 7, Dr. T. G. Longstaff will give the first of three lectures on "The Himalayan Region"; and on Saturday, April 9, Mr. W. W. Starmer will commence a course of three lectures on "Bells, Carillons and Chimes" (with musical illustrations). The Friday evening discourse on April 8 will be delivered by Prof. Percival Lowell, on "Lowell Observatory Photographs of the Planets"; on April 15 by Prof. W. J. Pope, on "The Chemical Significance of Crystal Structure"; and on April 22 by Mr. T. Thorne Baker, on "The Telegraphy of Photographs, Wireless and by Wire."

AFTER a number of slight earthquake shocks, an active eruption of Mount Etna commenced on March 23. Signor Ricco, the director of the observatory there, reported in a telegram from Nicolosi, a suburb of Belpasso, that the lava was advancing on March 24 in a stream more than 1500 feet wide, at a rate of upwards of 60 feet an hour. On March 25 he reported that the violence of the eruption had increased notably during the night, and that quantities of scoriæ were being thrown up, accompanied

by great explosions and rumbling. Five new craters on the south declivity of the mountain, in the same place as those of former eruptions, have been reported. Though on this day the lava stream was larger, it was descending more slowly. The *Times* Rome correspondent reported that on March 27 the activity of the eruption had diminished considerably, and that the lava streams had ceased to flow. The lava appears on this occasion to have flowed farther than in the eruption of 1892. There was renewed activity in the craters on March 28, and a fresh descent of lava, though in more moderate quantities. As yet there is no real anxiety for the safety of Nicolosi or Borello.

THE Reale Istituto Lombardo has awarded the following prizes:—the mathematical prize for an essay on theory of transformation groups is awarded to Prof. Ugo Amaldi, of Modena, for his essay on the determination of all the infinite continuous groups of analytic point transformations in three-dimensional space; the Cagnola prize, relating to miasma and contagion, is awarded to Prof. Aldo Castellani, of the hospital for tropical diseases at Colombo (Ceylon). From the Brambilla foundation for industrial prizes, awards have been made to Elia Bianchi, for his system of constructing dwelling houses formed of hollow concrete blocks, and to Renaldo Rossi, for whole-meal and anti-diabetes bread. The Fossati prize is awarded to Prof. Giuseppe Sterzi, of Padua, for his two published volumes on the central nervous system of vertebrates.

PROF. J. W. H. TRAIL, F.R.S., recently offered to the council of the Linnean Society a sum of money for the purpose of encouraging the study of protoplasm by means of an award to be made periodically. This generous offer has been gratefully accepted, and a special medal has been struck in bronze for presentation with the award, bearing on the obverse a portrait of Linnæus and on the reverse the words "Trail Award" and the name of the recipient in a wreath. It is proposed to make an award about once in every five years for original work bearing directly or indirectly upon the "physical basis of life," and, in accordance with the wishes of the donor, a wide interpretation will be given to the scope of the investigations. The first recipient of the award will be Prof. E. A. Minchin, professor of protozoology in the University of London, whose researches on sponges and protozoa have done so much to advance our knowledge of protoplasmic structures, and who is also the translator of Prof. Bütschli's well-known work on protoplasm.

THE February Bulletin of the Société d'Encouragement pour l'Industrie nationale contains the president's address delivered by M. Bertin at the general meeting in January last, and particulars concerning the award of prizes and medals on the same occasion. We notice that a grand gold medal was awarded to Sir Robert Hadfield, F.R.S. M. L. Baclé, representing the association's committee of chemical arts, points out that Sir Robert Hadfield has at least thirty-one memoirs to his credit extending over the period 1888 to 1909, and that these have been presented to various learned societies in England and America. Among the numerous other awards, we notice that the Lavoisier medal was awarded to M. le Comte de Chardonnet, for the creation of a new industry—that of artificial silks—and that the first award of the recently established Michel Perret medal for scientific workers, who by their researches have contributed to the progress of industrial chemistry, was made to MM. Gall and de Montlaur, for their electrochemical work.

THE New Zealand Survey Department is undertaking, in conjunction with the Marine Department, an inquiry into the tides of New Zealand. Hitherto the tide-tables for New Zealand in the New Zealand "Nautical Almanac" have been supplied by the U.S. Coast and Geodetic Survey, there having been no facilities in New Zealand for the necessary work. We learn from the *New Zealand Times* that the New Zealand Government has been invited by the Secretary of State for the Colonies to supply particulars as to the tides for insertion in the British Admiralty manuals for the use of the Navy and mercantile marine. It is hoped that the results from New Zealand, Australia, and other parts of the Pacific will lead to the thorough investigation of the tides of the Pacific Ocean, of which the available information is at present meagre. The latest scientific apparatus is being obtained from England, and the work has been placed in charge of Mr. C. E. Adams, secretary of the New Zealand Surveyors' Board, and is to be carried on actively at once.

IN the year 1891 Prof. Flinders Petrie found a curious mummy in a plundered tomb (supposed—though there is no positive proof—to have been that of a certain Ranefer or Ranofir) in the neighbourhood of the Medum Pyramid of King Snefru (*circa* 2900 B.C.). The fact that this was the oldest known mummy was duly recognised at the time, not only by its discoverer, but also by Prof. Maspero (see "The Dawn of Civilisation," p. 362), and with due care it was transported to England and lodged in the Museum of the Royal College of Surgeons. The significance of this mummy was not fully realised at the time, because it was generally supposed that the practice of embalming was as old as the history of Egypt, and many museums contained so-called "mummies" almost, if not quite, as ancient; and the importance attached to it seemed to diminish during the following decade, when some archæologists began describing earlier, even pre-dynastic, "mummies" (see "Guide to the First and Second Egyptian Rooms," British Museum). When, however, it was discovered (see *Cairo Scientific Journal*, May, 1908, p. 205) that there were no genuine mummies in the Cairo Museum (or in the British Museum) earlier than the time of the New Empire (*circa* 1580 B.C.), and that the bodies embalmed in the times of the tenth dynasty (*circa* 2200 B.C.) and twelfth dynasty (*circa* 2000 B.C.), found in 1907 by Mr. Quibell and Messrs. Lythgoe and Mace, respectively, were so fragile that they could not be moved without becoming reduced to mere bones and powder, the importance of the Medum mummy was more than rehabilitated, as was pointed out in NATURE in 1908 (vol. lxxviii., p. 342). The age of a mummy such as this was always open to question, seeing that it was found in a plundered tomb; but the important researches carried on by Dr. George A. Reisner at the Giza Pyramids during the last few years have now supplied the data which, when applied to the curious distinctive features of the Medum mummy, fix its age definitely at the period of the fifth dynasty (*circa* 2700 B.C.). Thus the specimen in the Royal College of Surgeons is of the utmost importance to the student of the history of embalming in Egypt, for it is more than 1100 years older than any *actual* mummy exhibited in any other museum, and 500 years older than any other mummy ever found.

MR. C. PEABODY has reprinted from the Putnam anniversary volume a valuable paper on certain quests and doles. He deals first with the rite of Hogmanay practised throughout western Europe, from the Isle of Man to France, in the period extending from late Advent to January. He connects it with a pre-Christian solstitial ceremony prevailing throughout northern and western

Europe. The English Waits fall into the same class. The French Dimanche des Brandons is connected by its fire rites with the ancient Pagan ceremonies at the vernal equinox. The paper is remarkable for a very elaborate collection of references to English and Continental folk-lore.

INFANTILISM and idiocy, and gigantism and idiocy, are the subjects of two papers by Dr. A. Marie in the *Bulletins et Mémoires de la Soc. Anth. de Paris* (5th Sér.), x., pp. 101, 113. He gives a classification of the various forms of dwarfing (nanism and infantilism). He believes that the nanism of the degenerate is nothing else than the permanence of an infantile stage through which all normal persons pass. One may consider the unprofitable age (*l'âge ingrat*) of transition between infancy and the final sprouting of growth at puberty as a kind of transitory normal acromegaly. Gigantism is only the acromegaly of infancy, the unprofitable age prolonged. Giants as well as dwarfs occur in families of degenerates.

THE Touareg, who have been exhibited at Paris, have been investigated by Dr. Atgier (*Bull. et Mém. de la Soc. Anth. de Paris*, 5th Sér., p. 222). The individuals studied were extremely limited in number, and necessarily belonged to the servile classes, as the upper-class Touareg would be too proud to exhibit themselves; consequently they represent a mixed group. On this slender foundation the following results have been arrived at. Excluding the Semitic element (Arabs, Jews, &c.) and the negro element (which is evident in those investigated), one finds the same ethnic groups as those which have peopled Europe—Indo-Europeans or Aryas—that is to say, blonds, brown brachycephals, and brown dolichocephals. Thus the expression "Berber" does not denote a race or variety of the human race, but a conventional term simply signifying those peoples of North Africa who are neither Semitic nor Negroid. According to Dr. Atgier, North Africa, like Europe, has Iberian, Celtic, Basque, and Kymric types, to which the term Aryas of Africa may be applied.

WE have received from the publishers (Bowes and Bowes, Cambridge) a copy of a lecture recently delivered by Mr. W. C. D. Whetham, F.R.S., in Trinity College, entitled "Eugenics and Unemployment." From his book on "The Family and the Nation," the lecturer cites evidence "that, with a few exceptions, the successful families in all classes are voluntarily restricting the number of their children, that their birth-rate has halved since 1876, and that the average number of children to the fertile marriage is now about three. About four children to the fertile marriage is the least number that will maintain a population unchanged. . . . But the population of the country as a whole is still expanding. Hence it follows that the unsuccessful families must still be multiplying rapidly. . . . We . . . are breeding fastest from our less efficient or definitely diseased strains." Having reached this conclusion, the lecturer begs his audience to dismiss any preconceptions and prejudices they may have as to pauperism and unemployment, and to look with him at the facts. He shows a curve based on the annual percentage of the unemployed members of trade unions, but points out that it "is roughly coincident with the cycles of good and bad trade," and "bears very little relation to the curve of general pauperism" or to "the total amount of distress in the country." He shows next how the curve based on the average number of paupers relieved per 1000 of the English and Welsh population has been declining "with natural fluctuations" from 1851 onwards. Since 1900 "there has been a slight increase, so slight that it is difficult to be sure that it is more than a temporary fluctuation on a curve which shows yearly changes." Despite this warning, Mr. Whetham subsequently suggests that "our failure to go on diminishing pauperism of late years may be due to a slight lowering of the average character and efficiency value of our population," arising from an artificial reduction of birth-rate among "the thrifty, the prudent and the far-seeing, quite as much as by the selfish and pleasure-loving."

EVIDENCE is steadily accumulating to show that most of the forest mammals formerly supposed to be restricted to the west coast of Africa extend eastwards into Uganda. The latest instance of this is afforded by the lemuroid pottos, of which Mr. O. Thomas described an East African species of the genus Perodicticus at a recent meeting of the Zoological Society. Sir H. H. Johnston had long since announced the existence of a Uganda potto, but no specimen was forthcoming.

IN No. 4 of the first volume of the *Queensland Naturalist* Mr. G. F. Bennett relates some of his early experiences in hunting and observing monotremes. On one occasion, after digging out the burrow for a distance of about 20 feet, he came upon a nest containing two young duck-bills, probably about a month old, each rolled up into a ball with the tail lying flat on the beak. In other instances the tail covered the head, and the beak rested on the stomach. All young ones of about a month old are plump with a greyish, bare skin.

AT the close of an article on the courtship of spiders, contributed by Prof. T. H. Montgomery, jun., to the March number of the *American Naturalist*, it is argued that Dr. Wallace's theory that the generally less conspicuous colour of female birds (as compared with their partners) is due to their need for greater protection will hold good also in the case of the Arachnida. "For the males do not develop their ornamentation until maturity, and they have much less need of protection than the females because they live usually not much longer than a few weeks after maturing, and take no part in the care of the young. The males have fulfilled their main function after impregnating the females, and they are of no use to the species thereafter. But the females live at least several months after maturing, in some cases several years, and they have the whole charge of the eggs and young."

THE March number of *Naturen* opens with an obituary, illustrated by a portrait, of Hans Christian Printz, Norway's oldest *savant*, who was born on April 13, 1817, and died, from an attack of influenza, on January 15 of this year in the ninety-third year of his age. On completing his education, Prof. Printz devoted much of his time to botany, and in 1864 made an important collecting tour; but about 1870 his attention was largely directed to meteorology, to which science he devoted much of his time in subsequent years. In addition to this, he was an enthusiastic egg-collector, and at one time possessed between 4000 and 5000 specimens, mainly, it would appear, Scandinavian, among which his greatest treasure was an egg of *Garrulus infaustus*. About 1871 this collection was acquired by the Bergen Museum.

THE nature and arrangement of the bony armour of the dinosaur Stegosaurus are discussed by Dr. R. S. Lull in the March issue of the *American Journal of Science*. In the specimen restored by Marsh a number of small ossicles were found adhering to the under surface of the lower jaw, and these, in the opinion of Dr. Lull, not only formed a gular shield, but also extended over a considerable part

of the body, as it is unreasonable to suppose that any portion of the skin of an armoured reptile would be unprotected. As regards the great vertical dorsal plates and caudal spines, the former of which Marsh regarded as forming a single series, it is practically certain that all were arranged in a double row. The vertical plates are considered to be nothing more than an ultra-development of the longitudinal vertical ridge on the horizontal scute of a crocodile or an unspecialised dinosaur like Ancylosaurus. Throughout the back the ribs are T-shaped in section in order to bear the weight of the plates. In the neck the latter are borne on short and notched transverse processes, but in the back these processes become longer and stouter, while in the sacral and anterior caudal region the bases of the plates are approximated and supported on the summits of the tall and expanded neural spines. On the other hand, the terminal third of the tail apparently formed a flexible aggressive weapon, in which the laterally divergent spines were inserted in the muscles between the neural spine and the centrum. Although the caudal spines of the English Kimeridgian Omosaurus or Dacentrus are structurally identical with those of one of the American species of Stegosaurus, in the lack of evidence as to the presence of vertical plates in the former the author is indisposed to admit the generic identity of the Old World and American types.

Dipterocarpus tuberculatus, known locally as the In tree, one of the most important members of the family Dipterocarpaceæ which bulks largely in the Burmese forests, forms the subject of a Forest Pamphlet (No. 13) compiled by Mr. R. S. Troup, and published by the Government of India. As a rule, it is a dominant tree, and an idea of its characteristic gregariousness may be obtained from computations, which estimate fifteen to twenty good-sized trees per acre. Fine specimens attain a height of 90 feet, with a clean bole of 60 feet and a girth of 10 feet. The wood is resinous and heavy, requiring bamboos if it has to be rafted; it is in considerable demand, as it works well, but is not durable if exposed.

A RECENT paper by Prof. G. Klebs, published in the *Sitzungsberichte der Heidelberger Akademie der Wissenschaften* (part v., 1909), and obtainable as a separate brochure, describes the modifications produced in flowers of Sempervivum when exposed to special cultural conditions, and incidentally contains some pertinent opinions on the subjects of variation in plants and inherited characters. The species, *S. acuminatum*, chosen for experiment is a recognised natural species. Plants were grown in rich soil and kept at a high temperature. The first inflorescences were cut off when quite young, and dormant inflorescences showing abnormalities were developed, from which self-fertilised seed was collected. Plants raised from the seed were grown, and increased vegetatively for three years. On flowering, the terminal inflorescences were removed as before, and the later flowers produced abnormalities, some new, others similar to those obtained before. These abnormal characters the author recognises as pathological modifications, yet regards their origin as intermediate between fluctuating variations and mutations.

MR. T. PETCH is responsible for three recent Circulars (vol. iv., Nos. 21–3) dealing with fungus diseases, issued from the Royal Botanic Gardens, Ceylon. A bark disease on Hevea and tea that appears during the south-west monsoon is attributed to *Corticium javanicum*. A more insidious disease of Hevea, known as "die-back," is started by a Glœosporium which paves the way for the destructive parasite, assigned to the genus Lasiodiplodia. The third pamphlet discusses very fully the stem-bleeding disease of the cocoa-nut caused by *Thielaviopsis aceticus*, a known parasite on sugar-cane in Java. The author communicates a number of details regarding the structure of the cocoa-nut palm. He distinguishes two types of tree, the one with a uniform columnar base, the other with a swollen base, and suggests that the latter, which is the less desirable, has been selected unconsciously by planters.

ACCORDING to the *Agricultural Journal of the Cape of Good Hope*, a certain amount of work on the hybridisation of wheat is being done in Cape Colony. At present less than half the wheat required for consumption is grown, the rest being imported; steps are therefore being taken to increase the area under crop. One of the chief difficulties about wheat-growing in the colony, and particularly in the western provinces, is the vast amount of destruction caused by rust; indeed, this was at one time so serious that farmers almost despaired of making wheat-growing a success. The importation of certain varieties more or less resistant to rust rather relieved matters, but none has yet been found fully to meet the local requirements. A cross between Gluyas and Darling promises to give useful results; Gluyas is resistant to rust but possesses very weak straw; Darling, on the other hand, possesses exceptionally strong straw. A hybrid, Union, has been picked out possessing strong straw and also resistant to rust. Another promising cross is between Gluyas and Du Toits, probably the finest milling wheat in the colony.

IN the *Sitzungsberichte* of the Vienna Academy of Sciences (Bd. cxviii., Heft vii.) P. Vujević discusses at some length the results of five years' temperature observations (1902–6) made at Belgrade. The readings were taken from freely exposed mercury thermometers, with cylindrical bulbs, at the earth's surface and at 0·4, 1·0, and 2·0 m. above it. The results are of special interest in view of the plea for such observations recently put forward in this country. The excess of the mean temperature from hourly readings of the freely exposed thermometer at 2 m. above the mean temperature in the screen at the same height is −0·1° C. in January, +0·6° in July. The mean difference is greatest (+2·0° C.) at 1 p.m. and least (−1·0° C.) at 8 p.m., in both cases in July. The occurrence of the minimum difference immediately after sunset is attributed to the retention of warm air in the screen. It is probably also due in part to the heat capacity of the screen itself. The point is of importance in connection with the analysis of the daily variation of temperature. Comparisons showed that the freely exposed thermometers gave higher readings at all levels on clear days, and lower readings on a cloudy day, than the aspirated thermometer of the Assmann instrument. The disturbance of the natural condition by the artificial aspiration would have some influence on these results. The observations from the freely exposed instruments are compared with one another without any attempt at correction. Throughout the year the temperature at the earth's surface is lower by night and higher near mid-day than that in the air. The extreme differences between the hourly means for surface and air are approximately +1·5°, −0·5° C. in January, +9·1°, −1·6° C. in April, and +15·2°, −1·0° C. in July. Deposition of dew diminishes the value of the negative difference, while clear weather increases both the positive and negative differences. The temperature on the exposed earth's surface was found to be considerably below that of the neighbouring upper surface of snow. It is assumed that the results are inter-comparable because the thermometers are similar, an assumption which is not justified unless the ventilation is the same for each; this

is probably not the case. No attempt is made to find the effect of varying natural ventilation.

MR. HERMANN GEWECKE sends us a dissertation on the influence of changes of internal structure on the physical properties of copper, electrical conductivity and density being the properties chiefly considered. In this pamphlet of ninety-three pages the author discusses at length the experimental results and theoretical conclusions of previous workers in the same field, and also describes his own measurements of electrical conductivity and determinations of density carried out on a series of copper wires drawn under known conditions. His results show that the effects of wire-drawing depend upon two actions, which occur simultaneously, but to a different relative extent when the circumstances of the drawing process are altered. These two actions are longitudinal extension and lateral compression, and their effects on conductivity and density are opposite in character. The net result is that, as wires become more severely hard-drawn, their density first increases and then decreases again, while the electrical conductivity is reduced—in some cases to an extent exceeding 1·5 per cent. Mr. Gewecke has also studied the annealing process in these wires, but although a temperature of 210° C. is found to mark the beginning of rapid annealing, this temperature is found to vary with the duration of heating. This supports the view of Turner and Levy that the change in the copper is rather of the nature of a continuous re-arrangement of structure than a transformation from one allotropic phase into another, as suggested by Dr. Beilby.

WE have before us a draft report of the science standing committee of the Concrete Institute relative to a proposed standard algebraical notation for formulæ and calculations employed with reference to reinforced concrete. It would appear that this was considered last September at Copenhagen by a committee of the International Commission on Reinforced Concrete (established by the International Association for Testing Materials), which approved of a three-alphabet system, the three alphabets employed to be Roman capital letters, Roman small letters, and Greek smalls. The principle of the initial letter is also adopted in the report, though this cannot be made a basis for agreement with Continental nations; it is held, no doubt rightly, that the use of a self-explanatory notation is in this matter more important than international uniformity. The use of Latin smalls for linear dimensions, intensities of forces, &c., and constants, Latin capitals for areas and volumes, and total forces, Greek smalls for angles and constants, is recommended. The notation can be extended by the use of subscript letters; thus B_c may be used for "bending moment at the centre of a beam." The scheme is not put forward as part of a comprehensive system; indeed, it is pointed out that letters fail if any attempt is made at a comprehensive system for engineering formulæ alone, not to speak of physics generally. It is, however, clearly desirable that some general plan should be agreed upon, by engineers at least, before an attempt is made to work out a detailed notation for each branch of engineering work. It may be that the only plan possible is the adoption of some general principles, and those suggested are sufficiently in accord with existing usage. Possibly the Engineering Standards Committee may be able to look into the matter.

A PAPER on compounding and superheating in Horwich locomotives was read at the Institution of Mechanical Engineers on March 7 by Mr. George Hughes, the chief mechanical engineer of the Lancashire and Yorkshire Railway. A number of comparative tests have been made by the author on compound and simple engines, leading to the conclusion that the compound engine is more economical and efficient than the simple. The compound engine developed a comparatively greater pull on the draw-bar for the same indicated horse-power. The Aintree to Accrington trials show an economy of 23 per cent., and the Goole to Smithy Bridge tests an economy of 22·5 per cent., in favour of the compound, based on the steam consumption per indicated horse-power. On the basis of total steam consumption per hour, the savings in these trials are 39·7 and 33·3 per cent. respectively. In fuel consumption the savings by the compound per indicated horse-power per hour are 16 per cent. and 8·3 per cent. respectively. As the horse-powers developed by the compound are less than for the simple engine, the total fuel savings are 36 per cent. and 23·7 per cent. respectively. Using Schmidt's system of superheating on a six-wheeled coupled goods engine, comparative trials show an economy in coal of 12·93 per cent. per ton-mile for the superheater. Tests on five passenger engines having Schmidt's superheaters, extending over some months, show a coal saving of 21·4 and 21·9 per cent. per ton-mile, computed from the drivers' and guards' returns. Mr. Hughes is to be congratulated on his success in dealing with very difficult problems when applied to locomotives.

AN improved form of mouth blow-pipe is submitted for inspection by Messrs. W. and J. George, Ltd., Great Charles Street, Birmingham. It is a burner and air-tube combined, connecting directly with the gas supply by means of rubber tubing, and dispensing with a Bunsen burner. A metal collar at the mouth-piece end keeps the latter clean by preventing it from coming into contact with the bench when laid down. A similar collar at the burner end keeps the flame from scorching the wood. If desired, the instrument can be clamped to a retort stand for use at any convenient height or angle, and it serves instead of a foot blow-pipe for many small operations, such as flame, charcoal, and "bead" tests, and light glass-blowing. The article is neatly and strongly constructed, and for convenience of renewal the several parts are made to a standard size.

THE January number of the *Bulletin de la Société d'Encouragement pour l'Industrie nationale* contains two reports by A. Moreau on two forms of road-tarring apparatus, due to MM. J. Lassailly and J. Vinsonneau respectively. The tar has to be extracted from the barrels, warmed to a temperature sufficient to reduce its viscosity and remove water, and applied to the road as uniformly and as rapidly as possible. In the first apparatus of M. J. Lassailly all these operations are carried out by steam, and require a minimum of skilled control. The Vinsonneau apparatus warms the tar to 80° C. by a thermosiphon heated by a petrol burner, and distributes it by means of compressed air. The cost of superficial tarring by either process is from 8 to 10 centimes per square metre treated.

A SECOND revised edition of the valuable little book on "Butter-making on the Farm," by Mr. C. W. Walker-Tisdale and Mr. T. R. Robinson, has just been issued by the publisher, Mr. J. North, Office of the *Dairy World and British Dairy Farmer*. The original work was favourably reviewed in NATURE of February 12, 1903, and the revised edition should secure for it many new readers. The subject-matter has been brought up-to-date by revision and additions. The price of the book remains 1*s*. net.

ERRATUM.—March 24, p. 104, col. 1, line 36, for "9 grams" read "6 grams."

OUR ASTRONOMICAL COLUMN.

Astronomical Occurrences in April:—

April 1. 8h. 29m. Minimum of Algol (β Persei).
11. Venus, apparent diameter 28·3″.
16. 16h. 0m. Saturn in conjunction with the Sun.
20–21. Epoch of April meteoric shower (Lyrids).
21. 10h. 10m. Minimum of Algol (β Persei).
23. 4h. 0m. Venus at greatest elongation (46° 13′ W.).
25. 5h. 10m. to 7h. 31m. Transit of Jupiter's Satellite III. (Ganymede).
30. Mercury visible as an evening star situated amongst the Pleiades.

The Spectrum of Comet 1910*a*.—In addition to the objective-prism spectra, already mentioned in these columns, MM. Deslandres and Idrac secured some spectra of comet 1910*a* with a slit-spectroscope of great light-gathering power, which they describe in No. 11 of the *Comptes rendus*.

The series of bands usually ascribed to hydrocarbons and cyanogen, respectively, are fully represented in these spectra, with the exception of the band at λ 460. The hydrocarbon bands of the comet's spectrum exhibit different intensities to the similar bands photographed in the laboratory, with the carbon arc or the Bunsen flame as the light-source, the most refrangible of the blue bands being the most intense. An "unknown" band at λ 402·1 is similar to one which M. Deslandres found in the spectrum of Morehouse's comet, which Prof. Fowler has since traced to some carbon compound at very low pressures, but other "unknown" bands seen in the earlier spectra are not shown in that of comet 1910*a*.

Halley's Comet in Japanese Records.—Some exceedingly interesting extracts from Japanese records, probably referring to early observations of Halley's comet, are communicated to No. 420 of the *Observatory* (March, p. 129) by Mr. K. Hirayama, of the Tokyo Observatory. They include accounts of comets which appeared in the years A.D. 684, 837, 912, 989, 1066, 1145, and 1222, and generally give some details as to the direction and appearance of the object. The details for the apparition of 1145 are especially full, the observer remarking on the peculiarity that the comet itself should remain bright after the disappearance of its tail; this he explains, four days later, as possibly due to the presence of the moon when the observation was made. The time of perihelion—as calculated by Messrs. Cowell and Crommelin—agrees with the time at which the comet was observed in the year A.D. 912.

Meteoric Astronomy.—Anyone interested in the observations of meteors, and those amateurs who, without the benefit of elaborate equipment, are seeking a field where observations may become both interesting and useful, should read Mr. Denning's article, on the progress of meteoric astronomy, in the current number of *Science Progress* (No. 15, p. 444). The writer therein gives a brief outline of the ideas concerning, and the observations of, meteors, and summarises the chief events in meteoric phenomena since 1798.

The Lyrids, Perseids, and Leonids are especially described, and the association between comets and meteors is concisely discussed. Mr. Denning also mentions that some showers persist, more or less actively, for months, and instances are not wanting where radiants continued in active play all the year round, the apparent position of the radiant remaining practically constant. He also makes it obvious that the study of meteoric phenomena needs recruits; the field is a large one, the observations are comparatively simple, and the results important. So far, photography has played but a small part, and there is ample scope for useful work by those possessing suitable cameras and a fair amount of persistent patience.

Stars with Variable Radial Velocities.—A number of observations of stars which have been found to exhibit variable radial velocities are published by Messrs. Campbell, Albrecht, and Wright in No. 173 of the Lick Observatory Bulletins. Among the twenty northern stars discussed may be noted κ Persei, α Ursæ Majoris, ρ Leonis, ο, ν, τ and ε Draconis, η Lyræ, σ Cygni, θ Cephei, and ζ Capricorni. Six southern stars, observed by the Chile observers, have also shown a variation of velocity in the line of sight; they are δ Canis Majoris, β Crucis, η Centauri, α Lupi, γ Apodis, and ν Scorpii.

In the same bulletin Dr. Curtis announces that the definitive reductions of the spectrograms of κ Centauri confirm the variation of that star's radial velocity. Dr. Campbell notes that thirteen years' observations of Procyon show that the radial velocities do not appear to have varied appreciably in a manner to accord with a period of forty years, more or less; they seem to harmonise with Dr. Auwers's conclusion that the orbit plane of the system is approximately tangent to the celestial sphere. There is, however, a suggestion of a secondary variation of the radial velocity, of very small amplitude and a period of about seven years, for the confirmation of which further observations are necessary.

The minimum of the radial velocity of the binary system in the triple system of Polaris is shown, by the Lick observations, to have been passed, and the velocity of the centre of mass of that system appears to be increasing rapidly. Therefore velocity observations of the bright component of the Polaris system during the next few months promise to have unusual weight in the determination of the period of the third member of the system around the centre of mass of the whole system.

Precautions Necessary in Photographic Photometry.—Under this title Mr. Parkhurst publishes a paper in the *Astrophysical Journal* (vol. xxxi., No. 1, p. 15) which contains a number of hints useful to all workers in astronomical photography.

During the work on photographic photometry, which has been carried on for a number of years at the Yerkes Observatory, it was found that the measures were affected by a number of errors introduced by differences in the method of development, by lack of uniformity in the photographic film, and by many other causes. These errors have now been fully investigated, and the results of the investigations are given in the present paper, illustrated by numerous curves. As an example of the results, it may be noted that at one point of the "developer curves" the density given by "pyro" introduces a difference equal to 0·3 mag. from that given by rodinal, whilst in the case of hydroquinone the resulting difference in magnitude amounts to 0·9. The necessity for rigidly controlling the time of development, the temperature of the developer, and other variables is just as forcibly shown by other curves.

Observations of Satellites.—No. 172 of the Lick Observatory Bulletin contains the measures, made by Prof. Aitken during the years 1906–9, of the satellites of Mars, Saturn, and Uranus. In the case of Mars the positions of the satellites are referred to the planet's limb, but for Uranus and Saturn each satellite is referred to another satellite, except in the case of Titania. The positions given in the tables are uncorrected, except for differential refraction.

Photographs of Jupiter's eighth satellite were obtained at Greenwich on January 19 and February 11, and the resulting positions, showing fair agreement with the ephemeris, are published in No. 4393 of the *Astronomische Nachrichten*.

RESEARCHES ON ALLOYS.[1]

The report referred to below was presented to a meeting of the Institution of Mechanical Engineers on January 21. The report itself is a memoir of some 175 pages and sixteen plates, and embodies the results of researches carried out during a period of two and a half years at the National Physical Laboratory. These researches constitute a continuation of the previous work of Messrs. Carpenter and Edwards on the alloys of copper and aluminium as recorded in the eighth report to the Alloys Research Committee. Owing to the magnitude of the task which would have been involved in undertaking a complete study of a ternary system of alloys, the authors at the outset decided to limit their investigations to those regions of the system

[1] Ninth Report to the Alloys Research Committee of the Institution of Mechanical Engineers, by Dr. Walter Rosenhain and Mr. F. C. A. H. Lantsberry, on "The Properties of Some Alloys of Copper, Aluminium and Manganese."

where results of practical interest were to be anticipated. As regards the heavy alloys, consisting principally of copper, important results were to be sought only in alloys containing more than 85 per cent. of copper, while at the aluminium end of the series only alloys containing more than 95 per cent. of aluminium could be expected to yield results of practical value. The study of the constitution of the alloys has, however, been pushed beyond these limits in order to render the data obtained over the "useful" range more intelligible.

FIG. 1.—Model of the liquidus surface of ternary alloys of copper with aluminum and manganese.

The report therefore includes a model of the "liquidus surface" of the ternary system over a range of alloys containing less than 11 per cent. of aluminium and less than 10 per cent. of manganese. This model is constructed on the well-known principle of trilinear coordinates, in which the range of compositions of ternary alloys is represented by an equilateral triangle; the liquidus surface is constructed by erecting a vertical ordinate representing the

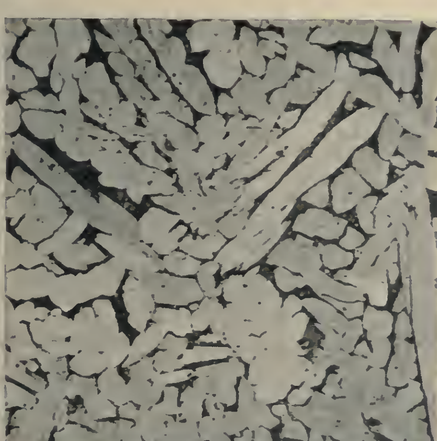


FIG. 2.—Micro-structure of alloy as cast in sand.

temperature of initial freezing, on the points representing the alloys examined. A photograph of the model, upon which contour lines representing each 10° C. have been drawn, is reproduced in Fig. 1. The well-marked minimum of the copper-aluminium series, occurring at a concentration of about 8½ per cent. aluminium, is continued into the ternary system in the form of a valley in the liquidus surface, and microscopic examination has shown that alloys to the right of this valley (*i.e.* nearer the copper side) are homogeneous, while those to the left are duplex. A comparison of the model with the mechanical properties of the alloys further indicates that in the ternary alloys, just as in the binary copper-aluminium series, the presence of the second phase to the left of the minimum renders the alloys stiffer, stronger, and less ductile.

Throughout the range covered by this model (which represents the data obtained from more than 100 different alloys) no new phase resulting from the presence of manganese can be detected. This result is of special interest, because some of the alloys included in this group, viz. those lying towards the left-hand corner of the model, are distinctly magnetic, their permeability increasing towards the extreme left-hand corner of the figure. If, therefore, the magnetic properties of these alloys (which approach the type of some of the well-known Heussler alloys) are due to the existence of a magnetic metallic compound, this compound must be soluble in either or both the phases found in these alloys.

A photomicrograph typical of the structure of alloys in this region is reproduced from Fig. 75 of the report (Fig. 2), representing the structure of an alloy containing 8·56 per cent. of aluminium, 4·77 per cent. of manganese, and 86·67 per cent. of copper in the sand-cast condition. The effects of heat-treatment on the microstructure of these alloys are very marked. Thus Fig. 122 of the report (Fig. 3) shows the structure of another alloy of this type after annealing at 900° C., both these photographs being taken at the same magnification (150 diameters). Quenching the same alloy from 900° C. produces a totally different structure, reproduced from Fig. 129 of the report (Fig. 4), and this change renders the alloy hard and brittle.

As regards alloys at the light end of the series, the introduction of manganese is found to give rise to the

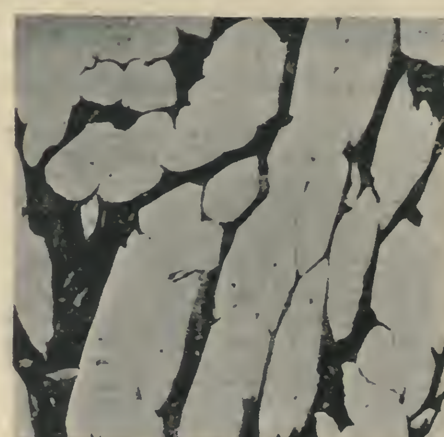


FIG. 3.—Micro-structure of alloy after long annealing at 900° C.

formation of a definite compound, Al_3Mn, which tends to render the alloys hard and brittle. If present in large proportions, this compound appears to undergo a more or less gradual change, which leads to the spontaneous disintegration of the alloys containing it; an ingot consisting of 65 per cent. aluminium and 35 per cent. manganese is a hard, metallic mass when first cooled, but falls to a fine crystalline powder in the course of six or eight hours, and this process appears to be independent of oxidation.

In the "useful" light alloys of the ternary system, however, such disintegration does not occur.

The mechanical properties found in the best of the alloys of the ternary system are remarkable. The authors suggest that alloys of copper with aluminium alone are generally contaminated with a certain proportion of alumina, formed when the aluminium is added to molten copper containing more or less oxygen; by the previous addition of manganese, which acts as a reducing agent, the formation of this alumina is inhibited and the properties of the resulting alloys are improved. It has been found that a small percentage of manganese renders the alloys more ductile without reducing their ultimate strength, while larger proportions of manganese increase the strength but lessen the ductility of the alloys. Sand-castings giving an ultimate strength of 36 tons per sq. inch with an elongation of 22·5 per cent. on 2 inches have been obtained, while in the form of rolled bars the best of the heavy ternary alloys reach an ultimate strength of 43 tons per sq. inch with 22 per cent. elongation. Perhaps the most remarkable result, however, is that obtained with one of these alloys in the hard-drawn condition, where an ultimate strength of 52 tons per sq. inch with 10 per cent. elongation has been obtained. This is probably the strongest alloy known, containing more than 80 per cent. of copper. The remarkable properties of this alloy led Dr. Rosenhain to take up the challenge recently thrown out by Sir Gerard

FIG. 4.—Micro-structure of alloy after quenching from 900° C.

Muntz in his presidential address to the Institute of Metals, to the effect that modern scientific attainments in metallurgy had not yet enabled us to produce a bronze cutting tool. By further cold-working one of these hard-drawn alloys under a powerful testing machine, a material was produced from which a chisel was ground, and with this it was found possible to incise hard stone or—with a different form of cutting edge—to cut wood so easily and cleanly that a lead-pencil could readily be sharpened with it.

A result of considerable importance has been obtained by means of abrasion tests on certain of these alloys; the test applied was one of simple wear against hardened steel rollers, the loss of weight being determined. It was found that the best of these alloys possess a very great resistance to abrasion of this kind far surpassing even the harder varieties of steel. This property, together with their very great strength and the fact that they can be machined and finished very readily, should render them of special value for the construction of scientific instruments, particularly for those parts where much mechanical wear has to be met. These alloys also possess a very great power of resisting corrosion, both by fresh- and sea-water, while tests made upon them at temperatures up to 500° C. indicate that they retain their strength up to 300° C.; these results suggest the possibility of their employment for the blades of steam-turbines working with superheated steam.

As regards the light alloys, containing more than 95 per cent. aluminium, the properties of the ternary alloys are not markedly superior to those of the aluminium-copper alloys, except, perhaps, that in the form of chill-castings a higher tensile strength has been obtained. The presence of manganese, however, appears to protect these alloys from corrosion to a marked extent, the specimens of these alloys exposed to sea-water, for instance, becoming coated with a black patina consisting largely of oxide of manganese. Specimens of some of these alloys have retained their original brightness after more than two years' exposure in the laboratory cupboards, thus indicating a decided superiority over pure aluminium, which has hitherto been regarded as decidedly superior to its alloys in regard to corrosion.

ELECTRICAL DISCHARGES OVER PHOTOGRAPHIC PLATES.

It is well known that when an electric discharge is allowed to take place over a photographic plate a latent image is formed which can be developed in the ordinary way. When one electrode consists of a metal plate placed at the back, and the other is a wire brought into contact with the middle of the sensitive side, a very great difference is obtained when a single spark is passed from an induction coil or Wimshurst machine according as to whether the wire electrode is the positive or the negative one. If it is positive, the figure—which is called a positive figure—consists of numerous ramifications suggesting meandering streams, while if it is negative the main lines in the figure change their directions very abruptly, and are terminated by expansions suggesting fans or palm-leaves. In each case the discharge may or may not pass to the edge of the plate; if it does, the corresponding line is very broad, with a finer, well-defined, intenser line passing midway through it. Such figures were obtained first by Mr. J. Brown, of Belfast, and have since been repeated by many experimentalists. Experiments made by Prof. J. A. McClelland and Mr. Campbell Swinton seem to render certain that the latent image is due to the luminosity of the discharge, and not to a direct electrical action.

I have recently made experiments with the object of extending our knowledge with respect to the formation of these figures, and the results have been communicated to the Röntgen Society, appearing in the society's journal for January.

My first idea was that if the paths of the discharge represent moving electricity they would be seriously modified in a perpendicular magnetic field. However, the greater part of the figure is apparently quite unchanged in such a field; the only evidence of change is in the trunk discharges that flow over the edge of the plate. These become still broader, the fine pilot spark, however, remaining apparently unshifted, and forming a sharp boundary to the trunk discharge along one edge. The direction of lateral shift is that corresponding to a wire carrying a current from the positive to the negative electrode.

A blast of air produces the same kind of effect. Indeed, if several radiating trunk discharges occur on the same plate, the effect in a perpendicular magnetic field is much the same as if a cyclonic blast of air had circulated over the surface of the plate.

The fine tracery lines in the fan-shaped expansions which terminate the lines of discharge in the case of a negative spark are very similar to the paths of the separate portions of an exploded projectile. Such paths are easily plotted by superposing a radial component of velocity, following any assumed law, upon the initial translatory velocity of the unexploded projectile. Owing to this similarity it is suggested that these tracery lines represent the actual paths of single ions or of simple groups of ions in the electrical field.

When the discharge takes place in a partial vacuum very considerable changes occur. In particular, as the exhaustion proceeds a new phenomenon appears, which reaches its most marked stage at about 17 cm. pressure. This is somewhat difficult to describe, and is shown in Fig. 1.

The wire terminal touched the plate nearly at its centre. Besides the trunk discharge ascending the plate are seen

two discharges in the shape of narrow triangles the bases of which are close to a *dark space* separating the glow surrounding them from a central rosette. The pointed ends are close to a *second dark space*, and are terminated by tuft discharges. These appearances show only imperfectly in the reproduction, but are exceedingly definite on the original negatives. The remarkable feature is the very sharp and well-defined edges which these triangles possess. It is suggested that there may be a connection between these and the phenomena of *electrostriction*, but so far no definite theory has been formulated. In very many cases there is visible a *dark continuation* of these squirts on the side of their bases, which suggests that the effects seen represent a part only of the electrical effects taking place. The shape of the squirts suggests that in one region they experience a pressure from the disturbance which creates the luminous glow through which they stretch, and that this pressure is replaced by a tension as soon as the second dark space is passed. The luminous glow bordered by the two dark spaces suggests a single stria as seen in a vacuum tube; the phenomena of ionisation in the two cases may be similar.

FIG. 1.—Discharge at a pressure of about 17 cm.

FIG. 2.—Negativ figure in coal-gas at ordinary pressure.

When the gas in which the plate is immersed is changed the effects obtained change also. Each gas produces a negative figure characteristic of itself. *The triangular squirts above referred to are given by air alone.* The negative figure in coal-gas at ordinary pressure is shown in Fig. 2. The figure in nitrogen is also very singular. It is noteworthy that the positive figures in various gases present very few differences from each other.

When a small metallic triangle placed on the sensitive film forms the electrode, some striking differences are obtained according as it is made the positive or the negative terminal. When it is positive the ramifications start in the main from the corners (Fig. 3); on the other hand, when it is negative a preference is shown to leave at right angles to the edges (Fig. 4).

FIG. 3.—Positive ramifications from corners of triangular electrode.

Throughout these descriptions it has been assumed that the discharges *leave* the electrode. It must be admitted that at present there is no proof that the streamers do not represent currents that advance *toward* the electrodes.

For some further details, as well as for numerous other reproductions, reference must be made to the paper in the Journal of the Röntgen Society from which the figures illustrating this article have been selected. Perhaps it should be added that these are photographic positives from the original photographic negatives.

FIG. 4.—Negative streamers exhibiting a preference to leave the triangle at right angles to edges.

ALFRED W. PORTER.

FORESTRY.[1]

THE present half-yearly issue of the Transactions of the Royal Scottish Arboricultural Society contains a considerable number of useful and interesting articles on forestry and woodcraft generally. An article entitled "The Duty of the State as Regards Afforestation" shows, in a striking summary of the opinions expressed on the subject by landowners, foresters, and men of science, that all are agreed that the State should encourage extended afforestation. The article indicates very clearly what the State can and should do with this object in view.

In "Afforestation and Local Taxation" Sir Kenneth Mackenzie, Bart., president of the society, shows the disastrous results to the local taxpayer which might follow indiscriminate afforestation in large, continuous blocks on land compulsorily purchased by the State. The State could do a great deal to encourage afforestation by private owners by removing the burdens which at present deter many from extending their plantations. In the words of the author:—"There is a premium offered at present against planting—as long as an owner occupies his land with sheep he only pays rates on three-eighths of its valuation. If he fences and plants it, he has to pay rates on the full value appearing in the Valuation Roll."

"The Sitka Spruce as a Tree for Hill Planting and General Afforestation" (with plate), by Mr. Crozier, Durris, is the most important article which has yet appeared regarding the sylvicultural characters and capabilities of this important conifer.

"Vegetable Remains from the Site of the Roman Military Station at Newstead, Melrose," is an article which will appeal to historians and antiquarians. Samples of deposits from the pits and trenches of the Roman station were examined by Mr. H. F. Tagg, of the Royal Botanic Garden, Edinburgh. The numerous twigs and branches examined belonged to some seven different species of trees which have always been considered indigenous. There was no evidence to show the presence in Britain, at the period of the Roman occupation of this station, of species of exceptional interest.

Mr. W. Mackenzie, Forester, Novar, contributes an article entitled "Underplanted Larch Plantations at Novar." The sylvicultural methods adopted to combat the ravages of the larch canker fungus are clearly and succinctly described.

"Continental Notes—Germany," by Mr. B. Ribbentrop, with figures, gives a review of the recent sylvicultural developments in that country, while Mr. A. G. Hobart-Hampden deals in a similar manner with French sylviculture.

The society's excursion to the forests of Bavaria, which took place last August, is interestingly described by Sir Andrew N. Agnew, Bart. In "Notes and Queries" are included many topics of great value to sylviculturists, and the "Reviews and Notices of Books" will bring them in touch with the recent literature on the subject.

[1] Transactions of the Royal Scottish Arboricultural Society, vol. xxiii., part i. (January, 1910).

WORK OF A LOCAL SCIENTIFIC SOCIETY.

THE value of the work accomplished by local scientific societies is, perhaps, not always given adequate recognition. On what may be described as the educational side, such societies create and foster interest in the world of nature; and out of this comes the desire to investigate parts of the field of science. A report, programme, and presidential address received recently from the North London Natural History Society provide evidence of the well-directed activity and progressive spirit which should be characteristic of a society that desires to extend a knowledge of science and promote its progress. The society is particularly to be congratulated upon its research committees, which are concerned, among other matters, with the flora, lepidoptera, and birds of the local district. This district covers an area within twenty miles of St. Paul's, and is subdivided into twelve sections for recording.

As instances of the valuable work which these committees accomplish, we mention a few points in the annual report for 1908—that for 1909 not yet being available. It appears that the adventitious flora of the district is spreading widely, while, as might be expected, the native flora is diminishing. Twenty species were recorded for the first time in 1908, making the total of 684 species for the district. Six of these were aliens, and eight were new records for the outlying salt marshes of West Thurrock. Six additions were made to the list of Lepidoptera, bringing the total up to 542. The ornithological research committee, which was inaugurated in 1908, records 110 different species of birds, of which seventy-nine were then known to nest within the district. Two members of the biological research committee, Messrs. L. B. Prout and A. Bacot, have carried out a research on inheritance in *Acidalia virgularia*, and a paper on the results of their investigation was communicated to the Royal Society in February of last year.

It is clear, therefore, that the members are actively engaged in the extension and advancement of scientific knowledge. We congratulate the society upon the keenness and energy of its members and committees, both of which are worthy of emulation by other local scientific societies. The society has just taken rooms in Salisbury House, Finsbury Circus, for its meeting-place, library, and collections. The annual subscription is only five shillings a year, being kept purposely low in order to place the advantages offered within the reach of everyone. It is to be hoped many new and faithful observers will thus be brought within the scientific field through the instrumentality of the society. Subjoined is the main part of the presidential address delivered before the society on January 11 by Mr. Louis B. Prout.

Let us have done with the days of a nearly stationary membership of about seventy, and an average attendance of perhaps a score or less; let us individually use every endeavour to attract to our society all the nature-lovers with whom we come into contact, whether they aspire to be called "naturalists" or not; let us remember that no one who lives within reach of London at all can now plead the *inaccessibility* of our meeting rooms as an excuse for holding aloof, and that, although our local researches will continue to justify our title of the "North London Natural History Society," yet there is nothing whatever to prevent our drawing upon South London just as extensively as upon North London for our membership. It is proverbial that nothing succeeds like success, and if only the next few months witness anything like the accession of new members which the new facilities make feasible, the future of our society should be well assured.

I have directed attention more than once to the love of *facts* which has characterised the early career of most of those naturalists who have become the most famous for their *theories*. The pioneers of evolution—Darwin, Wallace, and Bates—were all careful and accurate recorders at a time when most "mere collectors," at least in entomology, no more thought of labelling every specimen with locality and other details of information than the philatelist of labelling every stamp with the date of purchase and the name of the dealer from whom it was obtained. The two hobbies were very nearly on a par. The collecting was, without reservation, an end in itself, and if the entomologist had any advantage over his brother collector, it was only in that he was developing a somewhat more æsthetic taste, and probably—unless he, too, collected solely in auction-rooms and similar localities—a somewhat healthier body. Science and all branches of research were equally beyond the mental horizon of both; and how could it matter when or where a specimen was obtained, unless it might be from the mercenary motive of knowing how to obtain more? I do not say that the outlook of the average collector has radically changed; I do not even say that I wish it radically to change. I have no patience with the lordly being who speaks and writes disparagingly, or even contemptuously, of the "mere collector," and forgets that he only theorises because it amuses him to do so, just as the other only collects with like intent; but I think most have now been educated up to that point where they know that there *is* value in facts, and I believe that the majority of these are willing to "take themselves seriously" to the extent of observing and recording those facts; and if there are any listening to me who have *not*

yet realised these things, I would urge them from henceforth to bear their part in this movement, which may result in issues more far-reaching than any of us can at the moment conceive. Let me repeat that it is not necessary for every nature-lover, nor for every collector, to become a man of science; yet everyone may become in some measure a contributor to science.

When do the facts observed, or believed to have been observed, become *data*? Not when they are thrown away loosely into the chambers of memory, to be brought out again for use a few years later, clogged with the dust of time, or metamorphosed by long yet unsuspected contact with some subtle subconsciousness with which they ought to have had no affinity. No; the memory, however excellent, is not a safe repository for facts which are to be used as data; as soon as possible they ought to be reduced to writing. For it is impossible to overestimate the importance of absolute accuracy as a basis for all scientific generalisations.

I have often been impressed with the thought of the dependence of the greatest statisticians on the humblest recorders. Most of us have had questions addressed to us by Prof. Karl Pearson on simple questions of family statistics; and the entomologists have been asked to furnish to the Evolution Committee of the Royal Society certain data regarding percentages of black and of white moths among their favourites. These are but random examples which occur to me of what is constantly going on in the world of to-day; and yet on the faithfulness of the replies to such questions may well hang the entire development of the infant science of eugenics, the whole welfare, and perhaps ultimately the very continuance, of the human race. Fortunately, I believe—and one may hold this belief without a very over-exalted estimate of the average integrity of mankind—the danger of wilful perversion of facts which are to be used as data is extremely small. No doubt there are romancers here and there, and a de Rougemont or a Dr. Cook may set back the clock for a moment or two on occasions; but men such as these have generally some motive of self-interest behind their romancing, and I do not think there is any large army of hoaxers for hoaxing's sake.

Although, however, there is very little to fear from wilful deceivers of their fellows, there is very much to fear from unconscious self-deceivers. It is true that we have little to depend upon, whether in nature-study or in scientific research, but the evidence of our senses; but it is equally true that we must not allow ourselves to be deluded by our senses. I have on other occasions urged that the cardinal virtue of a naturalist is fidelity to his own observations, but he must make very sure that they *are* observations, and not imaginings. It is a perfectly well-known fact that even careful and experienced men of science have sometimes been led astray by certain psychological processes, and have seen things which it has afterwards been proved to demonstration were not, and could not have been, present for them to see.

The subtle enemy which all observers and recorders have to fight is, I believe, named by psychologists "suggestion," or, more particularly, "auto-suggestion." All of us know, and yet few of us give the knowledge its due weight in dealing with the analysis of our observations, that whatever is present as a mental background is ever liable to colour the newly arriving impressions from without. If something which we see falls in naturally with our expectations, that is, if its incidence on the mind causes no sense of jarring, we assume that it is correctly observed, and make no attempt at verification; if, on the other hand, it conflicts with our expectation—in other words, with past experiences or general habits of thought—we are sceptical, and demand a repetition of the observation before acknowledging that our senses have not deceived us. Now is there not really a great deal to be said in favour of a diametrically opposite course? Should we not be more suspicious of the expected when it is observed, and more trustful of the unexpected? I need scarcely add that I do not mean this to be the universal principle of life; we should have more than enough to do if, every time we entered our homes, we made it a duty to investigate whether the familiar faces and objects with which we met—and had been expecting to meet—might not in reality be the phantasms of our own brain! I am referring solely to phenomena which are under observation or investigation for furnishing scientific data; it is in these that we are too apt to accept the expected, perhaps also too apt to discredit the abnormal.

A plain and evident observation, made under no preconceived notion that it was about to be observed, may, in a normal state of health, be noted down as a fact, and thenceforth relied upon. If a member of our ornithological or Lepidoptera committee observes a bird or a moth with which he is well acquainted, he is entitled to make and to use the "record," which should be given full credence. Of course, there may be an error—infallibility is not an over-common attribute of man—and it is always satisfactory if two or three can make the observation simultaneously, or in such a way as to confirm one another, or if, as with our botanical committee, a specimen can be obtained as a voucher; but no good purpose is served by constant suspicion of data of this kind unless the recorder has proved himself untrustworthy. On the other hand, the observer himself should be the first to desire every possible verification, especially in cases of intricacy or difficulty of observation, such as in most microscopic work, or where he has any reason to suspect that "the wish is father to the thought." In all such cases a fact should not be considered as established until it has been verified two or three times, and under the most favourable conditions obtainable.

The most difficult questions of all have been left until last, and I really do not feel competent to give either an adequate answer. What facts or data are worth recording? And what steps should the recorder take to place them at the disposal of the specialist who could use them? In regard to the first question, I would say that, ideally, almost everything is worth recording; but, practically, life is too short, nature too long. While we are staying to record something commonplace, or already well known, we may be missing valuable opportunities of turning our attention to something more important. A retentive memory should be cultivated, so that we may know, to some extent, what has already been established by ourselves or others; and we shall then find that the most casual passing attention will suffice to accumulate any supplementary testimony that may be needed. For the rest, I think we ought to work upon the principle that a few things thoroughly observed and confirmed will form from us a worthier contribution to the sum total of science than a hundred half-observed and half-guessed at. As to the second question, To what use should the recorder put his data? I touched upon this in my former address, but there are great difficulties in the way of the application of sound methods, and the ideal arrangements are as yet far off. A society like ours ought to have a research committee in every possible field of nature-study, besides one or two committees for coordination of work along different lines—organisation, biology, topographical knowledge, bibliography—besides a sort of clearing-house for miscellaneous information; then (and not until then, I fear) it will be possible for observers rightly to place their data, and though much will be handed in which leads no further, there will also be much solid material for the rearing of the noblest edifices in the future of natural-history research.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Hebdomadal council has appointed Prof. Poulton, F.R.S., Dr. Dixey, fellow of Wadham College, and Dr. Malcolm Burr, New College, as representatives of the University at the International Congress of Entomology to be held at Brussels in August next.

WE learn from *Science* that Columbia University has received an anonymous gift of 70,000*l.* for the erection of a building for the faculty of philosophy. The University has also received anonymously 3000*l.* for work in agricultural education. From the same source we gather that a zoological laboratory is to be erected at the University of Pennsylvania, at a cost of about 50,000*l.* In making the announcement recently, Provost Harrison stated that it would be "the most complete biological laboratory yet

erected." By the will of Mrs. Mary A. Richardson, Tufts College is to receive 8000*l.* for fellowships.

By the will of the late Prof. Hilary Bauerman, the sum of 500*l.* is left to the Memorial Fund of the Iron and Steel Institute. The residue of his property (about 15,000*l.*) is left, subject to a life interest, upon trust to be applied by his trustees in the encouragement of the study of mineralogical science at the Royal School of Mines, by means of lectures on subjects of prominent or educational interest at the time, but which are not included in the ordinary list of subjects taught, and for making grants to enable students to make special investigations or to enable them to travel for the better pursuance of their studies.

In addition to the regular courses of instruction given by Profs. Sedgwick and MacBride and by Mr. Dobell at the Royal College of Science, a series of special courses on important departments of zoology are being delivered by lecturers, each as specialist in his particular branch. A course on heredity and variation, by Mr. A. D. Darbishire, has just been completed, and two other courses of great interest will commence shortly. One of these courses will be delivered by Dr. E. J. Allen, director of the Plymouth Marine Biological Station, and will treat of marine biology, with special reference to its bearing on fishery problems as well as on oceanic science. The question of the feasibility of the artificial rearing of marine animals of economic importance will also be dealt with. An opportunity will thus be afforded to the student of obtaining in a condensed form the results of a lifetime devoted to this form of research. The lectures will be delivered on Tuesdays, Wednesdays, and Fridays at 2 p.m., commencing April 19, and will be accompanied by practical work, for the benefit of which salt-water aquaria have been installed in the Royal College of Science, and are now in successful operation; at the conclusion of the course in London the practical part of the course will be continued at the Marine Laboratory, Plymouth, during July, for those desirous of prosecuting the study further. Another of these courses, treating of organs of embryonic and fœtal nutrition, is in charge of Mr. Richard Assheton, and will be held on Tuesdays and Thursdays at 5 p.m., beginning on Tuesday, April 19. This course will deal with the comparative anatomy and physiology of the placenta in a comprehensive way, taking into consideration all cases of trophic connection between mother and offspring throughout the Vertebrata, and tracing thus the fully developed placenta of the highest forms from its first beginning. An account of the œstrus cycle will also be given, and the question of the influence of the internal secretions of the generative organs on the organism will also be dealt with. The course will be accompanied by demonstrations and practical work. Such a course has never before been given in London, and it should enable a medical student to grasp the meaning and physiology of the placenta in a way unattainable to those who have only had acquaintance with the human type of the organ.

In an address at the recent annual banquet of the American Chemical Society, Dr. R. C. Maclaurin, president of the Massachusetts Institute of Technology, referred to the necessity for keeping industry in the closest possible touch with science. In the course of his remarks, he said:—"The awful example, the standing warning in this respect, is the case of England. There a few years ago was celebrated the fiftieth anniversary of an English chemist's epoch-making discovery of mauve, and yet the jubilee in honour of this man of science was the occasion of the funeral oration of the colour industry in his own country. This deplorable result was brought about entirely by two things that are closely related:—first, the failure to keep industry in close touch with science, and, second, the impatience of the manufacturer and his narrowness as a self-styled 'practical' man. The practical Englishman is too apt to be impatient of the slow processes of research. He wants to be compensated in hard cash, and at once. The German, on the other hand, has learned to be no less practical, but he has retained the traditions of a race of idealists plodding patiently and surely to success. But the field of *industrial* chemistry is not the only one in which the times are critical and exciting. That is equally true of the pure science itself. I hope my own predilection for physics does not mislead me into thinking that the most conspicuous development of chemistry during the past quarter of a century has been on the physical side; but, in any case, there can be no question that the artificial boundaries between physics and chemistry are being rapidly removed, and, of course, it is well to have it frequently brought home to us that all such boundaries are purely artificial. One point suggested by recent experiences is that we should pay more serious attention than we usually do to the logic of science, and have as clear ideas as possible as to what we are really aiming at, as to what we can reasonably expect to do and not to do. It seems unfortunate that men of science are still so much scared by the bogey of metaphysics. What we have to be afraid of is not metaphysics, but bad metaphysics, and it is difficult to accept the simple faith of many a man of science that his metaphysics is to be preferred to any other brand merely because it is either unconscious or naïve. A little quiet thought and study should at least have the good effect of enabling us to preserve our calm when things seem to be tumbling down. We should realise, perhaps, that a science like chemistry is, above all else, a work of art, and that concepts like atoms, energy, and the like are not much more than pigments with which we paint our pictures. The next generation may find new pigments or mix the old ones differently."

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, March 9.—Prof. W. W. Watts, F.R.S., president, in the chair.—E. E. L. **Dixon** and A. **Vaughan**: The Carboniferous succession in Gower (Glamorganshire). The succession in three districts in Gower is described. With the description of the lithological sequence are notes on some breccia-like limestones, on "lagoon-phases," and the origin of radiolarian cherts. From the faunal sequence it is concluded that many zones are characterised by the same assemblages as in the Bristol area. The lithological sequence shows (1) that over the area the depth of the Carboniferous sea underwent a cycle of change during Lower Avonian time, the initial deepening being followed by shallowing up to the top of the lower part, C_1, of the Syringothyris zone, deposited almost at sea-level; (2) that a cycle marked the ensuing period up to the top of the Seminula zone; (3) that a cycle took place in the Dibunophyllum zone, the latter reaching the surface; and (4) that a fourth cycle characterised the Posidonomya zone. A comparison of the sequences and thicknesses in the districts shows that the axis on which the movement during the first cycle hinged was different in direction from the axis during the second cycle. The bearing of these movements on the question of the delimitation of the divisions of the Avonian is then discussed. It is suggested that the base of the upper part, C_2, of the Syringothyris zone should form the base of the Upper Avonian. The base of C_2 in at least two localities is connected, faunally, with the zones below, whereas the fauna of the main mass of C_2 passes into S_1 without appreciable change other than the introduction of Lithostrotion. Probably the break between the Lower and the Upper Avonian should be taken at a level within C rather than at the base of the Seminula zone.

Physical Society, March 11.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Dr. W. H. **Eccles**: Coherers. A method of investigating detectors is developed with special reference to the relations between the energy given to the detector in the form of electrical vibrations and the energy delivered by the detector, as direct current, to the circuit of the indicating instrument. The author puts forward the hypothesis that the properties of an oxide coherer may arise solely from the temperature variations caused in the minute mass of oxide at the contact by the electrical oscillations and by the applied E.M.F. He examines the hypothesis mathematically, and shows that most of the phenomena recorded above can in this way be

accounted for as perfectly as the present state of the measurements permits.—G. C. **Simpson**: Earth-air electric currents. The paper describes a method for recording automatically the electrical current which passes from the earth into the air during periods of fine weather. A large plate (17 metres^2) was placed in the open as near to the ground as was consistent with efficient insulation; this was then connected to an insulated vessel, from which water issued through an orifice surrounded by an earth-connected cylinder. The water as it dropped from the insulated vessel carried away, by the well-known "collector" action, all the charge which the exposed plate received, and the latter remained at zero potential. The charged water drops were collected in a vessel connected to a self-registering electrometer, which was earth-connected for an instant at the end of every two minutes. The paper describes the sources of error and the method of determining the value of the earth-air current and of the conductivity of the air from the records of the electrometer.—Dr. B. D. **Steele**: An automatic Toepler pump designed to collect the gas from the apparatus being exhausted.

Zoological Society, March 15.—Mr. E. T. Newton, F.R.S., in the chair.—T. **Goodey**: A contribution to the skeletal anatomy of the fish *Chlamydoselachus anguineus*, Gar. The author dealt with the anatomy of the axial and appendicular skeleton, paying particular attention to the structure of the notochord. He stated that the notochord in this fish had generally been regarded as unconstricted except at the extreme anterior extremity, but that he had ascertained the presence of well-developed, calcified cyclospondylic centra at the anterior end of the column, and of calcified cyclospondylic centra of two sizes in the main caudal region.—W. R. **Ogilvie-Grant**: Additional notes on the birds of Hainan. The notes were based on a small collection of Hainan birds recently forwarded to the Zoological Society by Mr. Robert Douglas, of Shanghai, and, at the suggestion of Dr. Chalmers Mitchell, F.R.S., presented to the Natural History Museum. The collection contained several species of great interest, and two were described as new, namely, *Tephrodornis hainanus* and *Pitta douglasi*. Among the rarities, attention was directed to the remarkable magpie (*Temnurus niger*), with its curious truncate tail-feathers, the beautiful green jay (*Cissa katsumatae*), recently described by the Hon. Walter Rothschild, and a bulbul (*Pycnonotus sinensis*), not hitherto recorded from the island.—Dr. Einar **Lönnberg**: The variation of the sea-elephants.

Royal Meteorological Society, March 16.—Mr. H. Mellish, president, in the chair.—Captain H. G. **Lyons**: Climatic influences in Egypt and the Sudan. From early times the ancient Greeks recognised the marked difference between the climate of the Mediterranean and that of Africa, and Aristotle indicated correctly the rains of Ethiopia as the cause of the annual flood of the Nile. Travellers have supplemented our knowledge from time to time, but only within the last ten years has a network of meteorological stations given precision to our views and furnished a basis for further investigations. The comparatively low relief of the country, which lies as a vast land area in low latitudes, combined with the effect of the north-easterly trade winds which sweep over it, produce the hot and dry conditions which are so characteristic of north-eastern Africa. Modified somewhat in the north by the warm waters of the Mediterranean, and in the south by the rains of the monsoon in summer, the highest temperatures and most arid conditions are reached between Wadi Halfa and Dongola, where northerly winds, clear skies, and a great range of temperature prevail throughout the year. The important rains are those falling in Uganda, the southern plains of the Sudan, and on the tableland of Abyssinia, since they not only provide the whole supply of the Nile and its tributaries, but largely control their regimen. Fed by the south-easterly air currents blowing in from the Indian Ocean, these monsoon rains supply the equatorial lakes and the tributaries of the Nile; but it is the Abyssinian tableland, with its heavy summer rainfall, which is most effective, since it furnishes the whole of the Nile flood and enables the Nile to maintain itself through 1500 miles of desert. As the sole source of the flood, the variation of these rains directly determines the abundance or deficiency of Egypt's supply, so that this climatic problem is of immense importance. Hardly less important in these days of intensive cultivation of cotton is the study of the winter storms which occasionally break in the Sudan and Abyssinia, raising the level of the rivers and increasing the supply of the Nile appreciably at a time when the normal supply is inadequate. The climate of the region not only influences the water supply, but the great range of temperature rapidly disintegrates the rocks, and the wind removes the finer portion of the material. In this way the deserts are being constantly modified, and vast ranges of sand dunes are piled up. The distribution of vegetation is very markedly influenced both by the moisture and by the physical character of the country.

Linnean Society, March 17.—Dr. D. H. Scott, F.R.S., president, in the chair.—E. P. **Stebbing**: The life-history of *Chermes himalayensis* on the spruce (*Picea Morinda*) and silver fir (*Abies Webbiana*) of the N.W. Himalaya. The life-histories of the European species of Chermes, *C. abietis* and *C. viridis*, have been studied by Blochmann and L. Dreyfus in Germany, Cholodkovsky in Russia, and more recently by E. R. Burdon, of Cambridge. It is now well known that *C. viridis* has alternating series of generations upon the spruce and larch. The discovery that a species of Chermes formed galls on the spruce in the Himalaya was first reported by A. Smythies, of the Indian Foreign Service, in 1892. These were considered by the late Mr. Buckton to be *Chermes abietis*. Investigations commenced by the author in May, 1901, and carried on intermittently up to July, 1909, have led to the discovery that this Chermes, although an undescribed species, has a life-history somewhat similar to the European species of the genus, having series of agamic generations alternating between the spruce and silver fir (which grow together in mixture in the western Himalaya), with a sexual generation occurring but once a year, in the autumn, on the spruce. The paper shows that the Himalayan insect passes through similar generations to its European congeners, to which the names Fundatrices, Alatæ, Colonici, Sexuparæ, and Sexuales have already been given by European investigators. The periods at which these generations are to be found upon the trees in the Himalaya differ considerably, however, from the European ones, and are apparently chiefly governed by the appearance of the monsoon early in July in this region.—R. S. **Bagnall**: A contribution towards our knowledge of the neotropical Thysanoptera.

Institution of Mining and Metallurgy, March 17.—Mr. Edgar Taylor, president, in the chair.—W. A. **MacLeod**: The surface condenser in mining power plant. The author conducted a number of tests on the winding engines of a mine with which he was connected, the results of which were embodied in this paper, together with a vast amount of other information concerning the relative consumptions and efficiencies of condensing and non-condensing engines. He found that the employment of condensers was distinctly beneficial in both respects, even under the intermittent conditions attaching to most mining power plants, and the results of his investigations have enabled him to determine with some exactness the leading features to be emphasised in the laying down of a condensing plant suitable for work of a more or less intermittent nature, as in the case of winding engines.

CAMBRIDGE.

Philosophical Society, February 21.—Prof. Seward, vice-president, in the chair.—Prof. **Punnett**: Mimicry in Ceylon Rhopalocera, with some notes on the enemies of butterflies.—A. R. **Brown**: The Andaman Islands. Some of the features of the physical anthropology and the social life of the aborigines of the Andaman Islands were briefly described. The extremely primitive characteristics of the Andamanese are to be attributed to their long isolation from all other races and peoples, and the stability of population. —T. G. **Edwards**: The procession and pupation of the

larva of *Cnethocampa pinivora*. The processionary habits of the larva of this moth—which is abundant in the pine woods of the neighbourhood of Bordeaux—were first studied by Réaumur in 1736, and again by Fabre in the latter half of the last century. Both these writers describe the life-history and habits of the insect in considerable detail. The present paper, which is a summary of observations made during a fortnight spent at Arcachon, is an attempt to supplement these accounts by supplying information on certain points which still remain obscure. The procession is one of single file, the whole moving along a silken thread which is commenced by the leader and added to by all the larvæ in succession. The author found that though any larva could function as leader, yet the leader was capable of taking a real initiative in cases, such as the selection of a path, burrowing for pupation, &c., the satellites following him whether influenced by the same stimuli or not. The "circulating mass" is a formation which the larvæ frequently adopt when on the march. It consists in an assemblage of larvæ moving among each other, the mass, as a whole, remaining stationary. A "circulating mass" is always formed before the larvæ burrow for pupation. The leader appears to start the process of formation by assuming a zig-zag mode of progression, which is followed by the satellites. Though the order is completely broken up within the mass, yet it was found in every case observed that the leader of the procession which was re-formed from it was identical with that of the original procession. This was ascertained by marking the larvæ by means of fine sand or flour scattered over the dorsal papillæ. Pupation occurs beneath the ground, and is complete about nineteen days after burrowing. The burrowing is a collective process, in which all the larvæ within a circulating mass take part.—Prof. W. **Burnside**: Double sixes. —H. **Bateman**: The solution of a system of differential equations occurring in the theory of radio-active transformations.—Dr. **Young**: The change of order of integration in an improper repeated integral.—R. T. **Beatty**: The production of kathode particles by homogeneous Röntgen radiations. The kathode particles produced when these radiations pass through a thin silver leaf are absorbed by air, so that their coefficient of absorption is a linear function of the coefficient of absorption in aluminium of the exciting radiations. The total energy of the kathode particles set free in the leaf is proportional to the absorption by the leaf of the radiations. The range of these particles in hydrogen relative to that in air increases with the speed of the particles from 5 to 8. The total ionisation produced by any bundle of these kathode particles when totally absorbed in hydrogen is the same when air replaces hydrogen.—Sir J. J. **Thomson**: The scattering of rapidly moving electrified particles by matter, and its application to the determination of the number of corpuscles in the atoms of the various elements. An expression for the scattering of a pencil of rapidly moving electrified particles is found by the following method. First calculate the average deflection of the direction of motion of an electrified particle when passing through an atom which is assumed to consist of a large number of corpuscles placed in a sphere of uniform positive electrification; the expectation of any angular deflection after a large number of particles have passed through a large number of atoms can then be found by the theory of probability. In this way it is shown that the average angular deflection when a pencil of rapidly moving particles passes through a thin plate of thickness t is

$$\frac{e^2}{mv^2}\sqrt{\pi.\mathrm{N}.\left(64\mathrm{N}_0+\frac{\pi^2}{16}\mathrm{N}_0^2\right)t},$$

where v is the velocity of the particle, e the charge, and m the mass of the particle, N the number of atoms in unit volume of the plate, and N_0 the number of corpuscles in each atom in the plate; hence if we measure the scattering of such a pencil we can determine the value of N_0.

MANCHESTER.

Literary and Philosophical Society, February 22.—Mr. Francis Jones, president, in the chair.—A. **Brothers**: Halley's comet as seen in 1835, compared with Donati's in 1858. Good drawings or sketches of Halley's comet seem to be rare. Sir John Herschel saw the comet at the Cape of Good Hope, and from his sketches it was not very conspicuous. Struve in 1835 gives a sketch which shows it to have been bright, probably when it was near the sun, but as a brilliant object it must have been very inferior to several which were seen during the nineteenth century. The author has a distinct recollection of seeing the comet in 1835. The object certainly was not so bright as Struve shows it to have been, and still greatly inferior to Donati's comet. It is generally spoken of now as likely to appear as a brilliant object, but the author points out that there is little evidence for the assertion.—Dr. H. F. **Coward**: The inflammability of gas-mixtures. Hydrogen and oxygen mixtures were shown to be capable of inflammation at a much lower pressure than had been imagined previously if the igniting spark were produced in the most suitable manner. Minima for sparks of various nature with electrodes of various kinds were given.

March 8.—Mr. Francis Jones, president, in the chair.—D. M. S. **Watson**: Upper Liassic Reptilia, part ii., the Sauropterygia of the Whitby Museum. The chief Plesiosaur in the Whitby Museum is the type-specimen of *Plesiosaurus propinquus*, Blake. This is re-described in the present paper. It is a member of the large-headed group of Plesiosaurs, but differs considerably from other Liassic species, such as "*Thaumatosaurus*" *megacephalus* (Stutchbury) and *Rhomaleosaurus cramptoni* (Baily and Carte). It may possibly be necessary to found a new genus for the species. The other remains consist of small groups of vertebræ, one set of which, containing fifteen cervicals of *Sthenarosaurus dawkinsi* (Watson), may be Owen's type-specimen of *Plesiosaurus coelospondylus*.—Sir W. H. **Bailey**: Mr. Myring's recent discoveries of prehistoric pottery in Peru. Mr. Hewitt Myring, a mineralogist and mine owner, visited the Chincuna Valley in Peru, and explored some sand ridges with the view of finding something in the Inca graves. The valley, however, had been used as a cemetery, not by the Incas, but by the Chimus, who preceded them in the occupation of the country, and the work of exploration brought to light several hundred pieces of pottery of great variety and interest. The pieces are well preserved, owing to the absence of rain and the consequent dryness of the soil. This pottery, some of which recalls that of China, India, and Egypt, shows great care, skill, and art, especially in the modelling of the human face, and is remarkable in that no two pieces are alike, a fact which demonstrates, the author thinks, the intellectual liberty and original genius of these early craftsmen. The age of the pottery is not known, and may be several thousand years. About one-third of the pieces discovered have been secured for the British Museum, and it is hoped that shortly some portion of the collection may find a permanent home in Manchester.

EDINBURGH.

Royal Society, February 7.—Dr. J. Burgess, vice-president, in the chair.—Prof. Cossar **Ewart**: The short-tailed domestic sheep.—Principal **Laurie**: Electromotive force of cells with a single salt and two solvents. The paper gave some preliminary results with cells in which potassium iodide was the salt and water and alcohol the solvents, as, for example, the relation of the electromotive force to the strengths of the solutions, the variation with temperature, and the connected thermal properties, &c. In co-ordinating the curious results obtained, the author brought forward some suggestive views as to the distribution of molecular energy in the two solutions.—Prof. F. G. **Baily**: A stereoscopic optical illusion. When two objects are nearly in the line of vision, so that when one is clearly focussed the other appears as two images, one on each side of it, this clearly focussed object appears to be, under certain conditions, distinctly nearer to the observer than it really is. The phenomenon was noticed accidentally, and a careful study showed that it occurred only for a certain range of distances. It was evidently a physiological effect. —Drs. E. P. **Cathcart**, **J. Gray**, and A. **Black**: A new form of respitory respiratory calorimeter for physiological purposes. The temperature of the entering and issuing air was measured by platinum thermometers or thermoelectric junctions, the whole being under perfect automatic control,

so that the exact amount of heat generated within the calorimeter could be estimated.—Dr. T. **Muir**: The theory of persymmetric determinants in the historic order of development up to 1860, and the theory of bigradients in the historical order of development up to 1860.

February 21.—Dr. Traquair, F.R.S., vice-president, in the chair.—J. **Murray**: Scientific work of the British Antarctic Expedition of 1907–9. Moraines were traced on the sides of Mount Erebus to a height of 1100 feet. At the same time, there are abundant evidences of recent elevation of the land to the extent of several hundred feet, so that it cannot be said that glaciers ever stood so high as the moraines now stand. The tabular Antarctic icebergs appear to consist of compressed snow, not ice. They float very high, the depth of the substance below water being just about equal to the height above. By the fortunate re-discovery of a depôt laid down by Captain Scott on known bearings six years previously, the average rate of travel of the Great Ice Barrier at its western edge was found to be, on the average, about 500 yards per annum. The accumulation of drift on the Barrier surface was measured at the same place, and averaged just above 1 foot per annum of compressed snow. With these somewhat rough data as basis, it was estimated that the snow cliff, which to a height of 200 feet forms the face of the stratum at sea-level, must have originated some fifty miles to the south some 200 years ago. Yet under this long-continued weight of accumulated snow the material is not transformed into ice. The original glacier ice depressed beneath the accumulating snow seems to have been corroded away below sea-level, as the whole barrier moved outwards from the land valleys. Some important conclusions may be expected to result from a study of the rocks collected, especially if the discovery of coal and fossil wood should lead to the determination of their geological horizon. Of the optical phenomena observed, one of the most interesting was the projection, as long tapering dark bars through the air, of the shadows of mountain peaks. Under certain conditions the observer saw the shadow of Erebus cast on to Mount Lister, appearing as a circular arc reaching a height of 30° or more above the horizon. The observer was looking transversely to the direction of the shadow. Aurora displays were very frequent. They seemed to be dominated by the mass of Ross Island, and frequently circled Mount Erebus. The chief fact of biological interest was the abundant development of microscopic fauna and flora in the shallow lakes. The microfauna survives from year to year frozen in the ice without suffering injury. The lakes attain a temperature as high as 60° F. in summer, and in winter may go down to −40°. In some deeper lakes, which do not thaw in ordinary summers, many live animals were found at the bottom under 15 feet of ice. These must have been frozen for years. It was shown by experiments that they can endure being heated when in the dry condition almost to the boiling point and cooled to −108° F., a range of 300°. As regards the vital phenomena exhibited, there was a striking contrast between the fresh-water animals and those living in the sea not many yards away. These perform all their vital functions several degrees below the freezing point of fresh water, and are killed if the temperature either rises or falls one or two degrees. The rotifer fauna of the Antarctic lakes, which alone has been fully worked up, is very limited in numbers, and presents distinct peculiarities. Of the sixteen species recognised, five are at present unknown elsewhere, and many of the others differ from the usual types. These facts point to long isolation and difficulty of access to the region.

DUBLIN.

Royal Irish Academy, February 28.—Dr. F. A. Tarleton, president, in the chair.—J. J. **Simpson**: A revision of the Juncellid group of the Gorgonellidæ. According to the author, the Juncellid group of the family of flexible corals (Gorgonellidæ) comprises the genera Juncella, Ellisella, Scirpearia, Scirpearella, Ctenocella, and Nicella. Having had special facilities for studying these forms in the living condition when taking part in some of the cruises of the Indian Government steamer *Investigator*, the author has been able to add a good deal to the knowledge of their mode of life, structure, and distribution of which in some cases our information was very deficient. He directs special attention to the great taxonomic importance of the canal system and the character and variety in type of the minute spicules. A full description of the family Gorgonellidæ and its genera, with new diagnoses, conclude this contribution to our knowledge of the flexible corals.—J. **Adams** and G. H. **Pethybridge**: A census catalogue of Irish fungi. This paper contains an historical account of the previous work which has been done on the Irish fungi and Myxomycetes from the first published records in 1726 up to the present day, together with a complete bibliography of the subject. It also contains a complete list of all the fungi hitherto recorded as occurring in Ireland, together with a few hitherto unrecorded species. The arrangement follows that adopted in Engler and Prantl's "Pfianzenfamilien" in the main, and the distribution of each species in the four main provinces and in twelve sub-provinces is indicated. The total number of species, including Myxomycetes, recorded is 1464, which probably represents far from the actual number of species occurring in Ireland, seeing that the province of Connaught is at present almost virgin ground so far as these plants are concerned.—J. **Adams**: A list of synonyms of Irish algæ, with some additional records and observations. The greater part of the paper consists of a list of the names under which Irish species of algæ were originally published, and of the modern names of the species to which they are considered to be equivalent either in whole or in part. Some additional records have been brought together, numbering rather more than a hundred species. There is a revised census of species, a list of errata occurring in the "Synopsis of Irish Algæ" published in 1908, and some additional bibliographical records.

PARIS.

Academy of Sciences, March 21.—M. Émile Picard in the chair.—M. **Metchnikoff**: Experiments in typhoid fever. Hitherto it has been impossible to make satisfactory experiments with this disease on animals owing to the invariable fatality, but by making the attempt of inoculating a chimpanzee with typhoid matter from infected excreta, many interesting observations have been obtained, which are described.—J. **Guillaume**: Observations made on the sun at the Lyons Observatory during 1909.—A. **Chatelet**: A transformation of continuous arithmetic fractions.—A. **Cotton** and H. **Mouton**: The magnetic and electric bi-refractivity of aromatic liquids and the theory of molecular orientation.—Ch. **Maurain**: Variation with temperature of the magnetic properties of iron in a weak magnetic field.—M. **Robin**: The phenomenon of the extinction of sound in iron.—Jean **Meunier**: The laws of combustion.—J. **Ville** and W. **Mestrezat**: The hydrofluoric hydrolysis of cellulose.—L. **Blaringhem**: An unstable variety of Nigella, *Nigella damascena cristata*, obtained after a mutilation.—L. **Moreau** and E. **Vinet**: The use of lead arsenate in vine culture. Among other observations, it was definitely shown that the lead arsenate did not make its appearance subsequently in the wine.—Maurice **Holderer**: The filtration of diastases.—M. **Doyon**: The normal secretion in the liver of a substance preventing coagulation of the blood.—Jean **Giaja**: The isolation of a biose sugar derived from amygdalin.—MM. **Lagriffone** and **Roger**: Malta fever in France.—L. **Lindet**: The raising of flour in baking.—Ph. **Glangeaud**: The architecture of the central part of the Monts du Forez.—Marcellin **Boule**: Some vertebral fossils from the district south of Tunis.—M. **Nouailhac-Pioch** and Edmond **Maillet**: The rise of the Seine in January-February, 1910.—B. **Galitzine**: The determination of the epicentre of an earth tremor, from the data provided by one seismic station.

CALCUTTA.

Asiatic Society of Bengal, March 2.—I. H. **Burkill**: Notes on the pollination of flowers in India, note No. 7. A few observations made in the Central Provinces and Berar. The notes were made in the Central Provinces and Berar, chiefly in the Melghat. In the Melghat at the end of the rains, flower-visiting

insects are rare. *Megachile albifrons* was observed to be a regular visitor to cotton-flowers in north-eastern Buldana. As cotton has been asserted to be self-pollinated constantly in western India, and as some of the agricultural departments have been endeavouring to improve the plant on the assumption that races ought consequently to continue pure though grown by the side of other races, the observation has interest in directing attention to the necessity of relying on artificial pollination in breeding experiments. *Apis dorsata* was observed to work in the dawn and dusk on the flowers of *Dalbergia Sissoo* at Nagpur.—I. H. **Burkill**: Note on the spreading of *Croton sparsiflorus*, Morung, along the Assam-Bengal Railway. This introduced plant has reached Lumding and Gauhati by means of the Assam-Bengal Railway, along which it is to be found in several places between them and Chittagong. Chittagong is the port whereby, doubtless, it entered India.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part iv. for 1909, contains the following memoirs communicated to the society:—

July 3.—G. **Angenheister**: Cloud observations in Samoa.

November 20.—Rudolf H. **Weber**: Asymmetric and symmetric tensors.—The late K. **Zoeppritz** and L. **Geiger**: Seismic waves, iii., calculation of path and velocity of precursive waves; Poisson's constant in the interior of the earth.

December 4.—Researches from the Göttingen University chemical laboratory, xxii. Remarks on the terpinene question.

The "Business Communications," part ii. for 1909, include the text of the address presented to the University of Cambridge at the Darwin centenary, and a discourse by G. **Berthold** on organisation, morphogenesis, and metamorphosis in plants.

DIARY OF SOCIETIES.

FRIDAY, APRIL 1.

GEOLOGISTS' ASSOCIATION, at 8.—An Account of the District to be Visited at Whitsuntide (the Isle of Purbeck and Bournemouth): H. W. Monckton and F. Hovenden.

MONDAY, APRIL 4.

SOCIETY OF ENGINEERS, at 7.30.—Moulmein Waterworks: P. G. Scott.

ARISTOTELIAN SOCIETY, at 8.—Bergson's Theory of Instinct: H. Wildon Carr.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The India Rubber Industry: Dr. P. Schidrowitz.

VICTORIA INSTITUTE, at 4.30.—Darwinism and Malthus: Rev. J. White.

TUESDAY, APRIL 5.

ROYAL INSTITUTION, at 3.—The Modern Development of the Problem of Alcoholic Fermentation: Dr. A. Harden, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—On the Alimentary Tract of Certain Birds, and on the Mesenteric Relations of the Intestinal Loops: F. E. Beddard, F.R.S.—The Caudal Fin of the Teleostomi: R. H. Whitehouse.—Some Notes on Tasmanian Frogs: T. M. S. English.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The New Clyde Bridge of the Caledonian Railway at Glasgow: D. A. Matheson.—The Queen Alexandra Bridge over the River Wear, Sunderland: F. C. Buscarlet and A. Hunter.

FARADAY SOCIETY, at 8.—The Nature of the Action of Dyeing: W. P. Dreaper.—The Electrical Theory of Dyeing: Prof. W. W. Haldane Gee and W. Harrison.

WEDNESDAY, APRIL 6.

SOCIETY OF PUBLIC ANALYSTS, at 8.—A Note on the Composition of the Milk yielded from Cows on a Pasture manured with Potash and Phosphates: J. Golding and S. G. Paine.—Note on the Influence of Solvents on the Drying of Linseed Oil: W. E. F. Powney.—An Improved Method for the Estimation of Titanium: A. Gemmell.—Extraneous Mineral Matter in Rice: F. W. Richardson.

ENTOMOLOGICAL SOCIETY, at 8.—On the Behaviour of Coleoptera during Floods: N. H. Joy.

THURSDAY, APRIL 7.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

LINNEAN SOCIETY, at 8.—Elm-seedlings showing Mendelian Results: A. Henry.—On the Foraminifera and Ostracoda from Soundings, chiefly deep-water, collected round Funafuti by H.M.S. *Penguin*: F. Chapman.

RÖNTGEN SOCIETY, at 8.15.—Some methods of using the Alternating Current Mains for Röntgen Ray Work: Dr. G. B. Batten.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Progress of Electric Braking on the Glasgow Corporation Tramways: A. Gerrard.

FRIDAY, APRIL 8.

ROYAL INSTITUTION, at 9.—Lowell Observatory: Photographs of the Planets: Prof. Percival Lowell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Reconstruction and Extension of Egremont Ferry Pier: G. H. Hodgson and H. M. Gell.

PHYSICAL SOCIETY, at 8.—An Experimental Demonstration of the Loading of Artificial Telephone Cables: B. S. Cohen.—Further Tests of Brittle Materials: W. A. Scoble.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, APRIL 9.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer.

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THURSDAY, APRIL 7, 1910.

CRYSTALLOGRAPHY BY A PHYSICIST.

Cours de Physique. By Prof. H. Bouasse. Sixième partie, Etude des Symétries. Pp. 424. (Paris: Ch. Delagrave, n.d.) Price, 14 francs.

THIS sixth volume of the course of physics, prepared by the author to conform "aux programmes des Certificats et de l'Agrégation de Physique," deals with the subject of symmetry, both from the general physical standpoint and as it concerns crystals. The previous volumes have treated of mechanical physics, thermodynamics, electricity and magnetism, optics, and electro-optics. Besides actual symmetry, this sixth volume also discusses symmetrical deformation, double refraction in relation to the symmetry of crystals, the bearing of optical rotation on crystal symmetry, and a concluding brief account of liquid crystals. It presents many of the phenomena dealt with by the expert crystallographer from the very different outlook of the pure physicist, and such an outside view, by a competent authority, of a more or less special branch of science is usually of value, although one must not look either for specialised knowledge or intimate acquaintance with the phenomena described. In these days of specialists there are very few men able to deal without error with so many subjects as are included in the comprehensive course of Prof. Bouasse.

The reader is very much handicapped at the outset by the lack of any index, either of authors or subjects, but it is impossible not to be struck with the fact that the references to original investigations are almost entirely confined to those of French men of science. With the exception of a brief inevitable reference to Miller, whose notation was bound to be mentioned, we look in vain for any recognition of the many important contributions to our knowledge of both general and crystallographic symmetry which have been made during the last twenty years by British investigators, such as Maskelyne, Miers, Barlow, and Hilton, or of the large additions to chemical crystallography effected in this country. The work of Sohncke and Schönflies is referred to, and a passing mention of von Fedorow made, but anything approaching appreciation of the later most important work of the latter investigator and of Barlow is not forthcoming. Nor could any reference be found to the work on symmetry and crystal structure of Von Lang, Becke, Groth, or Muthmann. Gadolin is referred to, as he published in the French language, but the omission of British and Continental work to such an extent is a serious defect, as is also the fact that no references whatever to the literature of any original memoirs are vouchsafed.

Having accepted these limitations, however, and the further fact that practical details of crystallographic experimental work is not a feature of the book, an admirable summary of the work of Haüy, Lévy, Fresnel, Mallard, Bravais, Curie, Friedel, Bertrand, Sénarmont, and other French men of science, will be found. Moreover, when the author is on his own ground of pure physics, and especially in the discussion of such parts of his subject as are not affected by recent foreign work, his matter is excellent, vigorously and interestingly expressed, incisive and clear. One of the most valuable parts of the book is the chapter on space-lattices, which includes a capital account of the immensely important, even fundamental, work of Bravais, work which only increases in value as the years roll on. It is followed by a good description of the theory of "groups of movements," which has resulted in our knowledge of the 230 types of homogeneous structures, based chiefly, however, on the treatise of Schönflies.

A considerable part of the book is also occupied with the physics of homogeneous deformations, although all mention of work on the thermal dilatation of crystals subsequent to that of Fizeau is omitted, and the treatment of elasticity and elastic deformations is purely theoretical and lacks any reference to recent experimental work.

When the author enters the domain of the crystallographer it is, unfortunately, to display a complete want of knowledge of the immense progress which has been made, largely by British workers, in experimental methods, in the preparation of crystals of a high degree of perfection for the purposes of investigation, and of the highly accurate measurements which have been made during the last twenty years on such perfect crystals. The important laws governing the relations between crystalline structure and chemical constitution, especially those relating to the effect of the interchange of the variable elements in isomorphous series, which has been the main outcome of this work, is entirely ignored. It is with great surprise that we read, referring to the use of even an ordinary goniometer provided with telescope and collimator:—

"Ce procédé de haute précision n'est presque jamais employé. C'est que les faces d'un cristal sont loin d'être des miroirs parfaits. Elles sont souvent de très petites dimensions. Elles présentent souvent des irrégularités, des stries. . . . Les faces sont souvent courbes. Enfin, c'est un fait remarquable, les angles des cristaux cristallographiquement les plus beaux ne sont les mêmes d'un échantillon à l'autre ou d'un angle à son homologue qu'avec une tolérance souvent énorme. Il faut entendre par là que, mesurant, avec toute la précision possible, le même dièdre sur une série d'échantillons, ou les dièdres homologues d'un échantillon, on trouve des résultats qui peuvent différer de plus de dix minutes. Pour toutes ces raisons, une précision extrême est illusoire; l'emploi du goniomètre ordinaire, toujours inutile, est dans bien des cas absolument impossible."

It is difficult to understand how anyone holding such opinions as to the value of exact work in crystallography should wish to write a text-book on the subject. It is not by disseminating such opinions that the study of crystallography can be advanced, and young students attracted to a richly repaying and almost unopened branch of scientific investigation. If the worker in crystallography is content to take the first crystal he alights upon as the best sample procurable, he will, of course, conclude as the author has done. But if he takes the trouble to obtain the most perfect

procurable crystals for his investigations, and, if they are artificial chemical preparations, if he has followed and makes use of the recent work on the preparation of perfect individual crystals, and the precautions to be taken to avoid disturbance during growth, there will be a very different story to tell, and the deformations, striations, curvings, and lack of constancy of ten minutes or more will all disappear, and the angles will inform him, if he employs the most accurate goniometer in the market, of their constancy to the last minute. To speak, moreover, of "petites dimensions" as being a drawback is even more enlightening as to the author's lack of familiarity with practical crystallography. For it is precisely small crystals, varying from a very small pea to a pin's head in size, that the crystallographer chooses by preference for his measurements. For the liability to distortion is then at its minimum.

Sufficient will have been said to indicate the excellences and the defects of this volume, both striking in their way. Indeed, in spite of the aggravating defects which it has been essential to point out, the writer possesses so original and lively a style, and his remarks are often so well worth reading, that with all its shortcomings, the book has good and valuable qualities, and in the portions where the author is on his own domain is both well written and instructive.

A. E. H. Tutton.

THE ORIGIN OF THE DIAMOND.

Diamonds. By Sir William Crookes, F.R.S. Pp. xvi + 146. (London and New York: Harper and Brothers, 1909.) Price 2*s.* 6*d.* net.

ALL who have had the pleasure of hearing Sir William Crookes's lectures on the diamond and its origin will be glad to find the valuable information contained in them put into a permanent form in the little book before us.

The author has had exceptional opportunities for studying the subject. During two visits to South Africa, in 1896 and 1905, he was allowed by the managers of the De Beers mines to have unrestricted access to valuable sources of information; and, as is so well known, his own physical and chemical researches have been largely concerned with questions connected with the properties and origin of the most remarkable, as well as the most highly prized, of the gems.

Concerning the Kimberley diamond mines, as well as the alluvial deposits of South Africa, Sir William Crookes can write with authority from his personal observations. As illustrating "the kind of speculative gambling" which goes on in the former class of workings, we are told of a claim where the owner had not seen a diamond for a fortnight, but just before then he had picked out a diamond worth 300*l.*! On the other hand, the systematic work at the mines of the De Beers Company enables the management to regulate the annual supply with the greatest nicety, so as not to cause any fall in the price of the gem. In 1907 more than two and a half million carats were raised, which realised 6,452,597*l.* The mode of occurrence of the diamonds, the methods of working adopted at different times in the wonderful pipes that yield the gems, and the ingenious methods of treating the "blue ground" and sorting out the stones, are described and illustrated by photographs taken by the author himself.

Sir William Crookes had the opportunity of handling and taking a photograph of the celebrated "Cullinan diamond" before it was cut, and his description of it is of much interest. He tells us that:—

"A beam of polarised light passed in any direction through the stone, and then through an analyser, revealed colours in all cases, appearing brightest when the light passed along the greatest diameter—about 4 inches. Here the colours were very fine, but no regular figure was to be seen. Round a small black spot in the interior of the stone the colours were very vivid, changing and rotating round the spot as the analyser was turned. These observations indicated internal strain. The clearness throughout was remarkable, the stone being absolutely liquid like water, with the exception of a few flaws, dark graphitic spots, and coloured patches close to the outside. At one part near the surface there was an internal crack, showing well the colours of thin plates. At another point there was a milky, opaque mass, of a brown colour, with pieces of what looked like iron oxide. There were four cleavage planes of great smoothness and regularity. On other parts of the surface the crystalline structure was very marked. The edges were rounded in parts, and triangular markings (depressions) were to be seen. I also noticed square depressions, nearly as sharp and perfect as the triangular ones."

Interesting as this description undoubtedly is, we cannot but regret that, before this unique specimen was deprived of its interest for mineralogists by being cut, no opportunity was afforded to the author, or any other scientific investigator, of carrying out such a series of observations in the laboratory as would have enabled him to place on record all the facts about it which it was desirable to obtain.

A full account of the Cañon Diablo meteorite, with its enclosed diamonds, and of the vast crater-like depression in Arizona where it was found, is given in the concluding chapter. The author, in discussing the genesis of diamonds, is clearly of opinion that, whether of inter-terrestrial or of extra-terrestrial origin, the conclusion is established, both by observation and experiment, that the solvent from which the carbon has crystallised must have been molten iron.

In conclusion, we cannot but commend, to all desirous of learning what is known about the most beautiful and interesting of gems, this terse and attractive—but withal trustworthy and complete—summary of all the information on the subject which has up to the present been acquired.

J. W. J.

DIFFERENTIAL GEOMETRY.

A Treatise on the Differential Geometry of Curves and Surfaces. By Prof. L. P. Eisenhart. Pp. xii + 474. (London and Boston: Ginn and Co., n.d.) Price 20*s.*

THE well-known works of Darboux and Bianchi are so excellent, each in its own way, that one might be inclined to doubt whether another text-book on the subject was really required—at least, for the

present. But Prof. Eisenhart's work will be acceptable to those who prefer English to other tongues, or who wish to have the main results in a more condensed form than that in which Darboux and Bianchi present them.

The author of this book has been remarkably successful in giving a large amount of matter without an appearance of stodginess. The main reason for this is that, besides having a crisp style, he is very judicious in omitting those links of connecting analysis which the reader can easily supply for himself, or take for granted as calculations which have been done once for all. Without any attempt to enumerate even all the principal topics discussed, it may be said that we have a sufficient account of curvilinear coordinates, conformal and other representations, differential parameters, and the Christoffel (or Riemann) symbols; chapters on the deformation of surfaces, including Minding's problem, and the method of Weingarten; a very compact account of geodesics, minimal and other special surfaces; and finally chapters on rectilinear congruences, cyclic systems, and triply orthogonal systems of surfaces. Incidentally, many elegant special applications are given; thus, for instance, there are several interesting theorems due to Bonnet.

One remark is almost sure to occur to the reader of the book, namely, that the use of the differential parameters of the linear element is, in some parts of the theory, a very powerful engine, at any rate, for purposes of condensation and lucidity. An instance of this will be found in the chapter on geodesics (pp. 215–8). No serious student of differential geometry can fail to read Gauss's famous memoir and the early papers by Lagrange and others on minimal surfaces; few things are more instructive than a comparison of these "path-breaking" memoirs with the compact and symmetrical methods of the present day. The contrast is so great that the student who hopes to do something himself is more than ever bound to read original papers besides text-books and treatises; otherwise he will be tempted to imagine that new results fall out of the sky, so to speak, in their final and clearest and most elegant shape.

Fortunately Prof. Eisenhart's book contains a partial antidote in the shape of a very useful collection of unsolved examples. These are of all grades of difficulty, ranging from simple corollaries to adjacent bookwork to important theorems extracted from original papers. It would, perhaps, have been a help in these latter cases to give a reference; but the author has been sparing in his bibliography, as indeed mathematical writers can now afford to be, when the "Encyclopædie d. Math. Wiss." and the Royal Society's "Subject Index" are available.

In conclusion, a word on notation may be permitted. The Christoffel symbols are so essential in some parts of the theory that they ought to be of a simpler character than they are; for instance, the formulæ on p. 155 may, in a sense, be expressive, but they are cumbrous and ugly in the extreme. Could not the Mathematical Congress, or some other body, suggest a simplified notation, with some chance of its being generally adopted? G. B. M.

THE INSPECTION OF FOOD.

Food Inspection. By Hugh A. Macewen. Pp. viii + 256. (London: Blackie and Son, Ltd., 1909.) Price 5*s.* net.

THIS work has been written with the object of giving a clear and concise account of the inspection of meat and other foods, and of the principles underlying the hygienic production of prepared foods. It embodies the author's personal experience of the methods employed in Berlin and other German towns, America, and Great Britain. The book, which is well illustrated, includes chapters upon meat inspection; the inspection of live animals, and the symptoms of the more important diseases from which they suffer; the methods of slaughter; the diseases commonly met with in the abattoir; the construction and management of slaughter-houses and abattoirs; the inspection of fish, poultry, game, fruit, and vegetables; the preservation and storage of food; the inspection of prepared foods; and the law relating to the above subjects. In the anatomical description given the ox is taken as the type, and whenever any of its organs or parts differ markedly from those of other animals which concern the meat inspector, a special description is given. Important anatomical facts include a clear statement and good illustrations of the situation of the principal lymphatic glands in cattle and pigs.

An interesting and useful appendix deals with the German method of meat inspection as carried out in Berlin, and another appendix furnishes a short description of Chicago stockyards and packing-houses, and of American methods of meat inspection. The writer condemns the private slaughter-house which is so general in this country. If inspection is to be efficient it is essential that the inspector should be present while the slaughtering is going on. This is impossible in all the private slaughter-houses; and therefore no adequate system of meat inspection is possible where they are suffered to exist. The organs of unsound animals may be concealed or destroyed before the inspector appears on the scene, and the writer testifies to the fact that there is often a marked want of cleanliness in the methods of dressing and preparing the meat in private slaughter-houses, which is not to be witnessed in public abattoirs.

The work will not serve as a reference book. The information offered is not comprehensive enough for that purpose; but it is admirably designed to provide what the average food inspector and public-health student requires from a text-book. In parts the matter will be judged by the medical reader as very elementary, but the book has been written mainly to meet the needs of non-medical readers; the former, however, will find a very great deal to interest and instruct. Indeed, it may be read with profit by all who are interested in the public food supply, and it will probably prove to be the most serviceable text-book which candidates preparing for the examinations for the food inspector's certificate, granted by the Royal Sanitary Institute and other bodies, may consult. Both in respect of the matter it contains and

to the manner in which the work has been produced by the publishers, it is a satisfactory and remarkably cheap publication, but the illustration of the head of *Cysticercus bovis* on p. 112 is quite unworthy of the book, and more information should be given on the important subject of the inspection of canned food.

A NEW CATALOGUE OF HEMIPTERA.

Catalogue of the Hemiptera (Heteroptera), with Biological and Anatomical References, Lists of Food-Plants and Parasites, &c. Prefaced by a Discussion on Nomenclature, and an Analytical Table of Families. Vol. i., Cimicidæ. By G. W. Kirkaldy. Pp. xl+392. (Berlin: Felix L. Dames, 1909.)

Now that the study of entomology has become so widely extended, and of so much more importance, both medically and agriculturally, than was even suspected a few years ago, the publication of catalogues of the various orders and families of insects at frequent intervals has become an absolute necessity, for monographs and catalogues have become as indispensable to the study of any group of natural objects as are grammars and dictionaries to the study of a language. Often when a catalogue is published in several volumes, the stimulus to the study of the groups with which they deal is so great that the earlier ones are practically almost out of date before the later ones can be issued.

The last catalogue of the Hemiptera Heteroptera, by Lethierry and Severin, was not completed, though three volumes were published in 1893, 1894, and 1896, and therefore a new and complete catalogue was much wanted. Mr. Kirkaldy expected to complete it in six or seven volumes, of which this is the first. The second volume is stated to be in the press, and the third in active preparation.

Some years ago, the energetic author (who was a Scotchman) left the British Islands and went out to Honolulu, where he broke his leg, and it was probably this accident which gave him sufficient leisure to carry out so long and tedious a work as the present catalogue. We much regret that since the present volume was placed in our hands for review, we have received news of the death of the author at San Francisco, whither he had proceeded for an operation, which has terminated fatally.

Although we may not agree with all the author's dicta respecting nomenclature, his remarks on this difficult and intricate subject will be read with interest by students of other branches of zoology than that immediately concerned. There is also much information given respecting the bibliography, determination of types, and classification of the insects with which the author deals; and a table is given of the twenty-six families into which he divides the Heteroptera, of which only the first, Cimicidæ, is included in the present volume. The Cimicidæ are divided into ten subfamilies, as follows:—Cimicinæ (=Asopinæ), Pentatominæ, Phyllocephalinæ, Phlœinæ, Dinidorinæ, Cyrtocorinæ, Scutellerinæ, Aphylinæ, Coptosominæ (=Plataspinæ), and Tesseratominæ. Four more families were intended to be included in vol. ii., and three more in vol. iii.

In addition to full references to genera and species (the latter arranged in alphabetical order under each genus), references are given to biological, anatomical, and general notes, and to descriptions of metamorphoses; lists of food-plants, parasites, predators, prey, &c., are added. Fossil species are included. The range is also given at unusual length, and tables are added giving the number of species of each genus found in the various geographical regions and subregions.

On the whole, this is an unusually comprehensive catalogue, and we hope that it will be possible to make arrangements for its completion, notwithstanding the untimely death of the author. W. F. K.

OUR BOOK SHELF.

British Wild Flowers in their Natural Colours and Form. By the Rev. Prof. G. Henslow. Pp. xii+318; with more than 200 coloured illustrations by Miss Grace Layton. (London: S.P.C.K., 1910.) Price 8*s*.

Flowers of the Field. By the late Rev. C. A. Johns. Entirely rewritten and revised by Prof. G. S. Boulger. 32nd edition. Pp. lii+926. (London: S.P.C.K., 1910.) Price 7*s*. 6*d*.

It appears that the publishers of Anne Pratt's "Wild Flowers," issued many years ago in two small volumes, have deemed it advisable to arrange a complete revision, which has resulted in the thick octavo volume forming the subject of this notice. The new title suggests that the illustrations, about 200 in number, are regarded as the leading feature of the book, but the descriptive text will be found no less attractive and well adapted for the less professional student of flowers for whom the book is chiefly intended. Apart from the fact that the Royal Horticultural Society awarded a silver flora medal to the artist, Miss Layton, it would be gathered from observation that the original drawings were correct and graceful representations of the wild flowers, but several of the reproductions are not very satisfactory in the matter of colour; to get the best effect, the plates should be examined by artificial light.

With regard to the subject-matter, so far as the plants described in the earlier work have been re-illustrated, the author has incorporated much of the original material; beyond that, he has drawn on his extensive store of botanical knowledge for the text to accompany the figures of plants now introduced, and for the additional space consequent upon the increased size of the book. The information supplied refers to the characters of the selected and allied plants, and to the etymology of their names; also medicinal or economic uses and striking morphological features are noted. There are some discrepancies in the details regarding cultivated plants. Thus, the tree from which gamboge is obtained now passes as *Garcinia morella*; the pistillate plant of Garrya has been introduced into this country and cultivated at Kew for some years; further, there is reason to hope that the cultivation of indigo in India will not go under, as some users of the dye find it superior to the synthetic article.

Two more important features should be noticed; these are the inclusion of a synopsis of the families represented and the arrangement which follows the sequence of Bentham and Hooker; the glossary of technical terms will also be useful. It will be found that the reconstructed work is fuller and more scien-

tific than the original, which, however, served a very useful purpose in the past.

A new edition of Johns's "Flowers of the Field" differs only from the last remodelled version, published in 1905, by the addition of the coloured plates. This addition is obviously a concession to the modern practice of supplying illustrations in colour. The drawing of the plants is good, but the colour and printing are uneven in the reproduction.

Dynamo Laboratory Manual for Colleges and Technical Schools. Vol. I., Direct-current Studies and Tests. By W. S. Franklin and W. Esty, with the cooperation of S. E. Seyfert and C. E. Clewell. Pp. viii+152. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 7s. 6d. net.

THE advisability of publishing a laboratory manual which consists practically only of a reprint of the instructions given to the students in a particular college or university is a matter that is open to question. It may be objected that the instructions can only be of real value to those who have an equipment exactly the same as that in the laboratory of the authors, a coincidence that is likely to be rare, and that each teacher will preferably use instructions of his own, drawn up to suit the circumstances of his case. On the other hand, it may fairly be contended that such publications are of special value to teachers in that they enable them to compare their own methods with other people's, and to modify and improve their own courses as a result. From this point of view this volume, in common with others of the same kind, must be regarded as rather of value to the teacher than to the student. Indeed, as the instructions without the experiments are like the white of an egg without salt, the student can gain little from the present volume unless it is adopted by his teacher.

The volume deals only with direct-current machines. There is a short introduction dealing with general methods of measurement, &c., and the remainder of the book is divided into three parts, each describing sixteen tests. The experiments seem well chosen so as to bring out the more important points in direct-current dynamo work, and the instructions are full, if anything too full. There are a large number of clear diagrams.

The authors admit in their preface that their leaning is towards the purely pedagogical aspects of laboratory work; it is hardly the place in a review of a book written frankly on this basis to discuss whether this aspect is the best one, and it need only be said that, granting this premise, the course indicated in the volume before us seems admirably suited to get the most out of the laboratory training.

Mona's Records of the Earth's Changes. By Joseph Lewin. Pp. iv+100. (Douglas: Brown and Sons, Ltd., 1909.)

THIS is not, as might be supposed, a popular sketch of the geology of the Isle of Man. It is a description of certain highly hypothetical changes in the relations of sea and land that are held to have taken place within historic times. Five successive lowerings of the sea are said to have left their traces in wave-worn terraces, and these records were all formed in the last 2000 years (p. 39). Seeing that the Mona of Tacitus (p. 2) is moved by the author from Anglesey to the Isle of Man, we may well have doubts as to his historic judgment. One of the withdrawals of the sea is placed in 1538, so as to coincide with the enlargement of the shore near Pozzuoli; and such changes are attributed to movements of the axis of rotation of the earth, or to movements of the shell of the earth over the axis of rotation. The author does not seem quite clear as to which of these he adopts; but his context usually conveys the latter impression. His style may be gauged from the following portion of a sentence, the whole being too long for quotation (p. 94):—"But, according to the wobbling state of the poles of our earth at present, as described by our scientists at the earthquake, that caused so much damage and loss of life at Messina, as described in the *Daily Mail*, our earth at any moment, with another great earthquake, may lose its centre of gravity at the Poles, and move again slightly in the same direction as it has already done. . . ."

The general underlying conception is that the British Isles are being carried nearer to the North Pole, and away from the bulge of waters round equatorial regions. Palestine (p. 99) is to profit by the next change, which is due in a few years. There are some interesting scraps from old chronicles throughout the book, which save it from being judged too severely as a scientific treatise. G. A. J. C.

Ancient Angling Authors. By W. J. Turrell. Pp. xiii+239. (London: Gurney and Jackson, 1910.) Price 3s. 6d. net.

IT is fortunate that our English ancestors did not all agree with Plutarch in regarding fishing "as a filthy, base, illiberal employment," for the works which they have left us in praise and honour of the angler's art contain a valuable history of both tackle and methods. The fisherman has for a long time enjoyed a poor reputation for truthfulness, and Mr. Turrell exposes the angling author as a most unblushing plagiarist; but in spite of these shortcomings they are both excellent companions.

The respectable antiquity of many methods, reputable and otherwise, practised to-day is certainly remarkable; in 1657 one Barker had already discovered the use of salmon-roe as a bait, and salmon-fishing with the prawn was known in 1740. While Cotton (1676) may claim the credit of first describing how to take trout in clear water with the worm, the exact history of dry-fly fishing appears obscure, and cannot be definitely traced beyond the early part of the eighteenth century. So long ago as 1600, Taverner was recommending that fish-ponds should lie dry every other year, as is, we believe, the modern German practice, and ten years earlier Mascall had discussed the best methods of preserving fish.

There is, however, one habit of our ancestors which we have fortunately abandoned, to wit the anointing of our baits with strange and horrible unguents to attract the fish; from the beginning of the seventeenth to the middle of the eighteenth century recipes for the compounding of these form part and parcel of the current angling literature, and it is small wonder that these medleys of man's fat, cat's fat, assafœtida, mummy dust, and turpentine called forth the anger of Dr. Martin Lluelyn on those whose

> "pastes fox Rivers throat, . . .
> That from May to parcht October
> Scare a Minew can sleepe sober."

With the help of Mr. Turrell's little work and its really admirable index, much further information as to the early history of various parts of the angler's equipment and the different forms of his art may be readily gleaned, and the various subjects touched upon will be found to be explained by copious extracts from contemporary books. Nor must it be supposed that we are dealing with a mere compilation; Mr. Turrell has obviously gone to the very fountain-head for his information, and he is at times able to correct the errors of his predecessors and to throw fresh light upon doubtful points.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

The Term "Radian" in Trigonometry.

From a recently published part of the "New English Dictionary" it is to be inferred that the first authority for the use of the word "*radian*" was the "Treatise on Natural Philosophy" of Thomson and Tait, the date given being 1879—that is to say, the date of the new edition of part i. of vol. i. As the word has at least ten years of previous history, it may be desirable to put on record a few additional facts in regard to it. My own first use of it was in class-teaching in the College Hall at St. Andrews in 1869, and I possess a note-book, belonging to one of my students of that year, in which the word is used. The introduction of it was almost simultaneous with my proposal of the word "therm" in connection with the measurement of heat.

The advantages of the latter word I went so far as to point out in a letter to Nature dated almost exactly forty years ago (see vol. i., p. 606). At that time I was inclined to suggest the form "rad" in preference to "radial" or "radian," it being advantageous to have a monosyllable for the fundamental unit of a series if auxiliary units like "kilotherm," "millirad," &c., were likely to be called for (see Nature, vol. iii., p. 426).

It was in 1874, after several conversations on this and similar subjects with the late Prof. James Thomson, of Glasgow, and especially after an exchange of letters with the late Alexander J. Ellis, that the form "radian" was definitely adopted by me. In that year I came across the following passage in an interesting historico-biographical note written by Ellis as an appendix to his "Algebra Identified with Geometry" (London, 1874):—"Let u be a unit-line, then, if r and ζ be both real numbers, $r\epsilon^{\zeta i}u$ represents a line of the length ru and inclined to u at ζ radial angles" (p. 82), there being added in brackets the definition "2π radial angles = 4 right angles." As a consequence I wrote to him, and he declared at once for the form "radian," on the ground that it could be viewed as a contraction for "*radi*-al *an*-gle" in accordance with precedents in chemistry which he had himself followed in his nomenclature of the so-called "stigmatic" geometry. He also incidentally mentioned that he had used the expression "radial angle" from his Cambridge undergraduate days.

Thos. Muir.

Cape Town, South Africa, March 6.

The Fertilising Influence of Sunlight.

The letters on the above subject in Nature of February 17 and March 3 and 10 are of much interest. In many parts of the world artificial heating of the soil is a regular practice. For example, in the rice districts of heavy rainfall in the Bombay Presidency the seed-bed for transplanted rice and some small millets is almost invariably subjected to a process known in the vernacular as "rab." This consists of spreading a layer of branches, grass, cow-dung, &c., over the surface of the plot (often only a few metres square) selected as the site of the seed-bed. This material is then slowly burnt before the breaking of the monsoon.

There is a general agreement as to which kind of "rab" is best, that consisting largely of cow-dung (in the form of a plaster with chopped straw) being considered by far the best. Then comes that composed of the branches of certain species of Terminalia, after which come those of any available trees, and finally that composed of dried grass.

An experiment I conducted on these materials in the year 1906–7 at Lanowli, in the rice district above the Ghats between Bombay and Poona, gave the results stated below. Unfortunately, an untimely shower fell a few days before the material was burnt, so that the temperature of the soil was probably not raised so high as in ordinary seasons; this temperature was taken by scraping off the ashes at various points and inserting a thermometer 3 or 4 centimetres into the soil immediately after burning; it varied between 200° and 230° F.

The material was prepared and burnt in the ordinary method used by the natives; in addition, plots were added, one of which was manured with safflower (*Carthamia tinctoria*) cake, another with cow-dung, another with ashes scraped off a "rabed" plot, while in a fourth the soil was finely pulverised to a depth of about 8 cm., and in a fifth the surface soil was removed to this depth, placed on iron sheets, and heated from beneath until a temperature of 200° to 230° F. was reached, when it was allowed to cool.

At the time of transplanting, twenty average seedlings were taken from each of the plots, dried, and weighed.

The results were as follows:—

Treatment of plot	Average dry weight of seedlings (in grams) in each of the triplicate plots			Mean
	A	B	C	
1. Manured with safflower cake.	0·4097	0·4967	—	0·4532
2. "Rabed" with branches of Terminalia	0·0879	—	—	0·0879
3. "Rabed" with mixed branches	0·2181	0·1708	0·1430	0·1773
4. Manured with ashes of mixed branches	0·0797	0·1094	0·0954	0·0948
5. Manured with cow-dung	0·0928	0·0772	—	0·0850
6. "Rabed" with cow-dung	0·2561	0·3172	—	0·2866
7. Soil pulverised	0·0909	0·0625	0·1000	0·0845
8. Soil heated	0·3562	0·2968	0·2276	0·2935

It should be noted that owing to scarcity of this material at the time sufficient branches of Terminalia could not be obtained even for the single plot. Hence, probably, the poor result on this plot.

From the above it will be seen that the *raison d'être* of this process is to obtain the effect of heat, and neither to improve the physical condition of the soil (cf. plots 7 and 8) nor to supply plant food (see plots 4 and 5). The ashes have practically no value, and the natives state that it is of no consequence when the ashes, as is often the case, are removed by wind.

The enormous effect of safflower cake is well known, an application to sugar-cane being many times more efficient than that of any other cake when applied to give equal quantities of nitrogen. The reason for this is under investigation.

The fertilising effect of heat on soils has been known for ages, as witness the ancient practice above detailed. That, however, it is due to the causes assigned by Drs. Russell and Hutchinson, viz. a partial sterilisation of the soil, is very much open to doubt. In their extremely interesting work at Rothamsted they find an increase in bacterial activity and rate of increased decomposition of organic matter after partial sterilisation associated with an increased crop yield. There is the possibility, however, that these latter phenomena are accompaniments, and not the causes, of the increased crop-yields, all being the result of a destruction of toxic material in the soil. In any case, the theory put forward is apparently incapable of explaining many causes of sterility in soil, and is, apparently, not a general explanation that has any practical bearing on the general question of soil fertility. For example, it is difficult to see how it can account for the fact that certain plants will not grow in the immediate neighbourhood of others, as the present writer has found to be the case ("Memoirs of the Department of Agriculture in India," Bot. Ser., vol. xi., No. 3, April, 1908).

The excellent work of the U.S. Bureau of Soils has proved that roots of plants excrete a toxic substance. The present writer has noted the same phenomenon, and has further isolated the substance from water in which plants have been cultivated. A further paper on this question is in preparation. It may, however, be stated here that if water rendered toxic by the growth in it of plants is shaken with benzene, toluene, chloroform, or carbon bisulphide (the antiseptics used in experiments for partially sterilising soil), this toxic substance is rendered insoluble, and therefore innocuous.

As an example, when such water is shaken with toluene, an emulsion is formed which floats on the surface of the water. If this emulsion is poured off and the toluene and water allowed to evaporate, a residue is left

which is not soluble in water (or at least not in the quantity of water from which it was extracted).

It therefore appears probable that the effect of toluene on the soil is to render insoluble and innocuous this toxic substance. Similarly with the other antiseptics mentioned; ether apparently does not convert the substance into an insoluble form, and its method of acting is being investigated.

The writer has also found that heating to dryness on a water-bath decomposes this substance, and it is probable when in the soil that a lower temperature will suffice. It seems probable, therefore, that the fertilising effect of sunlight will be found to be due to the decomposition of this toxic substance.

F. FLETCHER.

School of Agriculture, Gizeh, Egypt.

TRANSCASPIAN ARCHÆOLOGY.[1]

IN the two volumes referred to below are incorporated the results of the American expedition which visited Russian Turkestan under the direction of Mr. Raphael Pumpelly, the well-known geologist, in 1904, and, besides conducting excavations at Anau, near Askhabad, collected material bearing on the physiography of the Central Asian deserts and oases. Thus the work of the expedition was two-fold. On one hand, we are presented with geological and physiographical observations, illustrating changes which have taken place in the character of Central Asia; on the other, we have a full and able presentment of the archæological material obtained from the excavations at Anau, including a very complete ceramic record. We should add that the excavations were directed by Dr. Hubert Schmidt, of Berlin, who joined the staff of the expedition for that purpose.

On the physical side, Mr. Pumpelly, assisted by Messrs. Davis, Huntington, and R. W. Pumpelly, who were also members of the expedition, found traces in High Asia of several great glacial expansions during the Glacial period. According to the picture which he gives us, there existed a cap of continental ice, thousands of feet thick, which spread over nearly the whole of European Russia; and Central Asia was covered by a huge inland sea, larger than the Mediterranean, and fed by rivers flowing from the snow and ice. The sub-Glacial period was marked by a general trend towards desolation, accompanied by the disappearance of the ice-cap from Russia and a diminution of the great glaciers on the southern mountains. As evaporation became more rapid than the inflow of water, the inland sea shrunk and broke up into smaller basins, and the dried silts of seas and rivers were carried by the wind in great columns of dust across the earth. The lightest material was carried farthest, and deposited in beds of loess, the extraordinarily fine and fertile soil which covers a great part of the surface of Northern China and Turkestan, and extends in a continuous zone from north of the Caspian to Austria. The heavier silts, in the form of sands, moved more slowly along the surface of the plains, where they formed great seas of sand-dunes, heaped up in places to a height of more than a hundred feet. We may note that to the shifting of such sand-deserts in historic times we owe the burial of cities in the Khotan region, which have been so successfully excavated by Dr. Stein for the Indian Government. With regard to the geological side of his work, we certainly think that Mr. Pumpelly's researches on the spot tend to confirm Richthofen's theory of the wind-borne origin of loess, and he has succeeded in obtaining further evidence of his own modification of the theory as to the important part played by river silts, and the chemical action of vegetation, in furnishing the constituents of loess.

As a deduction from his archæological researches, Mr. Pumpelly would regard the Central Asian oases as the fountain-head of Western Asiatic culture. According to his theory, their inhabitants were isolated from Africa and Europe from the Glacial period onward, and their cultural requirements were consequently evolved in complete independence. Changes in climatic conditions, however, took place, under which the early civilisations in these regions tended to disappear, and these gave rise to extensive migrations, which eventually reacted on the outside world. In support of his theory, Mr. Pumpelly would trace the early appearance of wheat and barley in Babylonia and Egypt, and the presence of certain breeds of domestic animals, to their first establishment in the Transcaspian oases. Moreover, he would place the original home of the Sumerians in Central Asia, where, before their arrival in Babylonia and their subsequent fusion with Semitic nomads, he pictures them as having already acquired the elements of their racial culture and organisation under the stern discipline of a struggle with nature. The absence of any form of writing in the mounds of Anau may be cited as negative evidence against any racial, or even cultural, connection with the Sumerians, though, as we shall see later, a study of the ceramic points to some influence having been exerted from that quarter on the early cultures of Susa in Elam.

In this connection it is indeed a moot point whether the parent civilisation was not that of Elam herself.

FIG. 1.—(1) The North Kurgan at Anau, in Russian Turkestan, with the Camp of the Pumpelly Expedition in the foreground. (2) The South Kurgan at Anau, showing excavations in progress.

[1] Explorations in Turkestan: Expedition of 1904. Prehistoric Civilisations of Anau. Origins, Growth, and Influence of Environment. Edited by Raphael Pumpelly. Vol. i., pp. xxxvi+240+vi; vol. ii., pp. x+(241–494)+x; with 97 plates and 548 illustrations, including maps and plans. (Washington: Carnegie Institution, 1908.)

It would be tempting to seek the origins of the Babylonian and Elamite cultures in the highlands of Asia, for it is not difficult to assign causes for a succession of migrations westward. The nomad population of Central Asia, swollen to the limit of the supporting capacity of its pasture lands, would be forced to seek outlets into more favoured regions. This process may well have been accelerated by periods of drought, due to the climatic changes which have left no uncertain traces behind them in the character of the country itself. The present condition of aridity would appear to have been of continual growth, with certain oscillations, since the Glacial period. Already in prehistoric times the seas of sand-dunes had en-

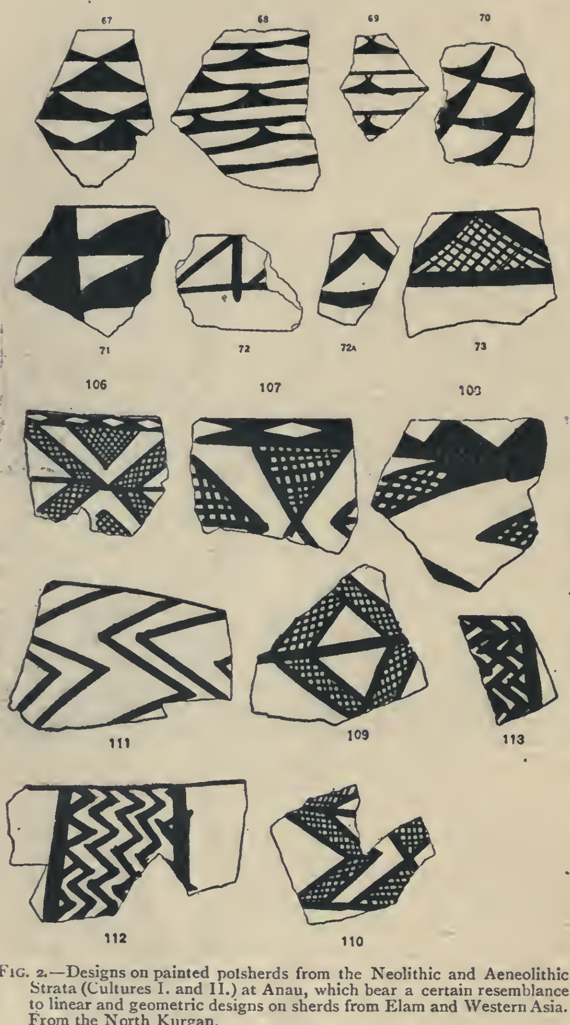

FIG. 2.—Designs on painted potsherds from the Neolithic and Aeneolithic Strata (Cultures I. and II.) at Anau, which bear a certain resemblance to linear and geometric designs on sherds from Elam and Western Asia. From the North Kurgan.

croached upon the fertile plains of loess, and the delta-oases, at the mouths of streams emerging from the mountains, or at points where larger rivers lost themselves on the surface of the plains, have been the favourite home of man. It was at one of these, at Anau, near Askhabad, some three hundred miles east of the Caspian, that the Pumpelly expedition conducted excavations in 1904, and obtained its principal material for archæological study.

Near the middle of the Anau oasis, and about a mile from one another, are the two Kurgans, hills with rounded contours, rising some forty and fifty feet above the plain, and marking the sites of long-forgotten cities. The structure of the North Kurgan had already been exposed by a trench cut in it some twenty-five years ago by General Komorof, which showed a series of stratified remains, including the bones of animals and potsherds of plain and painted ware. It was this trench which first directed Mr. Pumpelly's attention to the mound, and his subsequent excavations, both here and in the South Kurgan, laid bare a stratified structure of precisely similar character. The strata represented successive occupations of the sites, and, as their inhabitants lived in houses built of sun-dried brick, the hills gradually rose in height by the accumulation of *débris* from previous settlements. Of the two hills, the North Kurgan was of earliest formation, its earlier strata representing a Stone-age culture, while its upper layers belong to an æneolithic stage of civilisation. The third culture, that of the South Kurgan, dates from a Copper age. The archæological part of the work was left wholly to Dr. Schmidt, assisted by Miss Brooks, and to his admirable method of noting the precise spot and level of every object recovered we owe the possibility of tracing the gradual development of culture during the successive periods of settlement. Moreover, the Transcaspian Railway passes little more than half a mile to the north of the North Kurgan, so that no difficulty and little risk were involved in the conveyance to Europe of all the archæological material obtained. The collection of animal bones from the North Kurgan alone weighed nearly half a ton, but the neighbourhood of the railway enabled the whole collection to be transported without trouble to Dr. Duerst, of Zürich, who contributes a report on them as part vi. in the second volume.

The cultural progress of the three great periods is most clearly revealed by the pottery, which exhibits a gradual evolution in form, technique, and decoration. Although the vessels of the first two cultures are hand-made, and the wheel was not introduced until the advent of the Copper age, yet the vessels of both earlier epochs are excellent ceramic productions. It would be out of place in the present review to discuss in detail the problems presented by a study of the potsherds, so admirably edited by Dr. Schmidt; but it may be noted that many of the geometric designs occurring on pottery of the earlier periods from North Kurgan bear a striking resemblance to designs on pottery found by MM. Gautier and Lampre at Mussian, and by M. de Morgan at Susa. This may well point to some connection between the stone and early metal-using cultures of Transcaspia and Elam, while the baked clay figurines from the copper culture of South Kurgan may be due to some early cultural contact with Babylonia, as first suggested by Prof. Sayce. Whether we may treat as significant a further resemblance which has recently been pointed out by Mr. H. R. Hall between the Persian and Transcaspian sherds, on the one side, and fragments of similar geometric pottery on sites in Asia Minor and even in Northern Greece, is a subject outside the scope of the present review. That such problems should be even mooted is a sufficient testimony to the importance of the archæological material obtained by the Pumpelly expedition.

In fact, Mr. Pumpelly, though not an archæologist himself, has, with Dr. Schmidt's valuable cooperation, produced a work of the first importance to students of archæology. In the first five chapters of part i. of the first volume he has admirably summarised the results obtained by the expedition, but there is one feature of his treatment to which we feel we

must take exception. Mr. Pumpelly's attitude with regard to prehistoric chronology is indicated by the remark with which he introduces his description of the sub-Glacial period in Central Asia. "Remember," he says, "that while we look, in our time-perspective, millenniums are as seconds." This generous and imaginative method of treating the lapse of time, which is no doubt a very necessary virtue in the geologist, is wholly destructive of an accurate chronology in archæological study. Moreover, the attempt to apply geological methods of dating to the purely artificial growth of a city site is totally unscientific, and we are glad to note from a remark at the end of Mr. Pumpelly's preface that he has already realised the possibility of error in at least one of his assumptions. Such dates as 8000 B.C., which he suggests for the beginning of the Neolithic settlement at North Kurgan, or 5000 B.C., for the beginning of the Copper age in South Kurgan, are wholly fanciful. It is true that very early dates were at one time in vogue, both in Egyptian and more particularly in Babylonian archæology; but these are now given up, and it is recognised that the earliest Sumerian remains in Babylonia do not date from an earlier period than the end of the fourth millennium B.C., while the Neolithic remains at Susa are probably not of a very much earlier period. While these facts naturally affect the dates suggested by Mr. Pumpelly for the cultures at Anau, they do not in any way upset their relative arrangement. It is perhaps significant that Dr. Schmidt nowhere mentions a date; and throughout the whole work the material is presented in such a way that the student is in no way hampered or misled.

Fig. 3.—Terracotta figurines from the Copper Age Stratum (Culture III.) at Anau, suggesting a cultural connection with Babylonia. From the South Kurgan.

The success of the expedition, and the admirable volumes which set forth its achievements and results, are a striking testimony to Mr. Pumpelly's enthusiasm and powers of organisation, and at the same time show the high scientific aims and standards which inspire American archæological and geological research at the present time. L. W. King.

SOURED MILK: ITS NATURE, PREPARATION, AND USES.

There seems to be little doubt that as age advances the microbial flora of the human intestine, especially of the lower portion or large intestine, often undergoes a change both in the number and in the character of the micro-organisms present. From middle life onwards the number of microbes increases, and species capable of inducing putrefactive decomposition of proteins become more abundant. This change can be roughly gauged by making microscopical preparations of the dejecta and staining by the Gram process, a selective method by which certain organisms only are stained. In the child's dejecta Gram-staining microbes are relatively scanty and are mostly *Bacillus bifidus and B. acidophilus*, and it is noteworthy that these are lactic-acid producing bacilli. In and after middle life Gram-staining forms usually become more and more numerous, the Gram-staining species now being principally *Bacillus putrificus* and *B. Welchii*, bacteria which induce marked putrefactive decomposition of proteins.[1] In unhealthy conditions of the intestinal tract somewhat similar changes or various abnormal fermentations may occur.

Metchnikoff[2] in a study of the nature of senility formulated the hypothesis that it is caused, partially at least, by auto-intoxication, poisoning by the absorption of products derived from the action of micro-organisms in the digestive tract. Such poisons would be the products of the putrefactive decompositions brought about by the micro-organisms named, and also bodies belonging to the phenol series which are formed by the action of *Bacillus coli*, which is always present in the intestines, becomes more and more numerous from youth to old age, and which also multiplies excessively in unhealthy conditions of the digestive tract. In seeking for some agent which would combat the multiplication of micro-organisms in the intestine, particularly these harmful forms, Metchnikoff conceived that lactic acid, which has no deleterious action in the human economy, would probably effect the end desired, since the growth of these bacteria is inhibited by a moderate percentage of this acid. Bienstock, for example, found that the B. *putrificus* is inhibited in growth by *B. coli* thanks to its acid-producing power, the acid formed, though small in amount, being lactic acid. Simply to introduce the acid as such would, however, be of little use, for it would be absorbed and decomposed long before it reached the large intestine. Metchnikoff therefore sought for some means whereby lactic acid might be formed *in situ*, and naturally fell back on the use of lactic-acid-producing bacteria, which, if they could be established in the large intestine, might there produce sufficient lactic acid to inhibit the growth of the putrefactive and other deleterious forms. But the problem was not an easy one, for it entailed the finding of a lactic acid ferment which would grow at body tem-

1 Herter, "Bacterial Infections of the Digestive Tract," 1907.
2 "On the Prolongation of Human Life."

perature (99° F.) and maintain itself in spite of the competition of the other micro-organisms present. The ordinary lactic acid ferments found in milk grow best at 75°–85° F., and are unsuitable.

Metchnikoff says[1] "I had no illusion as to the difficulty sure to be encountered in any effort to introduce lactic microbes into the intestinal flora which has been preoccupied by a multitude of other microbes. To make surer of the result, I chose the lactic microbe which is the strongest as an acid producer. It is found in the *Yoghurt,* which originates in Bulgaria. The same bacillus has also been isolated from the *leben* of Egypt; and it is now proved that it is found in the curdled milk of the whole Balkan peninsula, and even in the Don region of Russia." Metchnikoff also noted that some of those who consumed a diet of little else than the soured milk lived to an advanced age. This then was the origin of the use of Bulgarian sour milk, and of the introduction of artificial substitutes for the natural article. It may be added that the use of sour milk seems to be widespread in the East, for it is found also in Turkey, Siberia, and Asia Minor, and in India under the name of "Dadhi."[2] As Chaterjee says, "The extensive use of one or other varieties of fermented milk, produced by means of a special ferment in Eastern countries, probably owes its origin to the difficulty of preserving milk in a sweet condition for a long time, in comparison to cold countries; milk when undergoing spontaneous decomposition in hot climates becomes changed within a few hours to a foul-smelling fluid in which the casein and the fat have undergone liquefaction, whereas, when fermented by means of the special ferment the decomposing, gas-producing, proteolytic bacilli are killed off by the more vigorous organism of the ferment, which has no destructive action on the fatty or albuminous constitutents of milk, so that by this means milk can be kept in a condition fit for consumption for a long time."

The bacteriology of the various natural sour milks is somewhat complex and not yet fully elucidated, although considerable research has been devoted to it. Micro-organisms of a peculiar type are present in all. One of the first to be isolated was the *Bacillus bulgaricus,* a large Gram-staining, non-sporing, rod-shaped organism, which grows best at temperatures between 110° F. and 120° F. Development, however, is slow even at the optimum temperature, taking three days for the maximum production of lactic acid in milk, and it is therefore unsuited for the preparation of artificial soured milk. Another organism is the "granule bacillus" (Körnchenbacillus) of Kuntze. This is probably the organism so often spoken of as the "bacillus of Massol," and is widely used for the preparation of soured milk, as it grows rapidly and well at a temperature of about 100° F. and produces a relatively high percentage of lactic acid. The name of "granule bacillus" is derived from the fact that granules which stain deeply are present in the bacterial cell. In all the natural soured milks somewhat similar micro-organisms are to be found. It is of interest that Kuntze has suggested that these Bulgarian lactic ferments are allied to the *B. acidophilus* and *B. bifidus,* which, as already stated, are present in the child's intestine, and they are probably primarily of intestinal origin.

In natural sour milks the special lactic acid ferments are always associated with other ordinary lactic acid bacteria, particularly a Streptococcus (*S. lacticus*), and a mixed culture of this last-named organism with the bacillus of Massol, presents advantages over the use of the latter alone.[1] For instance, when the *B. bulgaricus* grows alone in milk it has some effect on the fat, producing small quantities of nauseous tasting substances, but Metchnikoff has shown that this result is entirely obviated by a symbiotic growth with an ordinary lactic acid organism. The ingestion of milk soured by an ordinary lactic acid organism also tends to produce in the intestine an acid environment which favours the growth and persistence of the special lactic ferment, the bacillus of Massol.

Various procedures are adopted for the preparation of the natural sour milks. According to one account, Yoghurt is prepared by boiling milk until it has diminished to half its volume by evaporation, it is then allowed to cool somewhat and a little of a previously prepared sour milk is added and the whole allowed to stand in a warm place until next day. Another method is to wipe round a wooden bowl with a piece of cheese (presumably prepared with the sour milk) and then to introduce into the bowl the boiled milk. Dadhi is prepared by boiling milk for some time, cooling to blood-heat, and then inoculating with a needle dipped in a former brew. The inoculated milk is covered with a blanket and kept in a warm place for 12 hours.

For the artificial production of soured milks the milk is well boiled in order to sterilise it and destroy undesirable organisms, and when it has cooled sufficiently a "starter" consisting of a pure culture of the proper lactic ferments is added. The inoculated milk is then kept at 100° F. or thereabouts for from 10 to 24 hours, according to the amount of starter added, and should then be fit for use. Many "starters," both liquid and solid (tablets), are to be had, but only a few are to be recommended, as some are grossly contaminated with undesirable bacteria. Another method is to add a little of the previous day's preparation to the milk to be soured. Some of the large dairy companies also supply the soured milk ready for consumption.

Considerable care must be exercised in preparation to use sterilised vessels and to safeguard the milk from contamination during incubation. The milk properly prepared should be thoroughly curdled, possess a not unpleasant tart flavour, and have a marked acid reaction. Some of the older "starters" contained sporing bacilli which though they curdled the milk (owing to tryptic ferments) gave rise to little or no acidity. Preparations containing a combination of the bacillus of Massol, with *Streptococcus lacticus* or *lebenis,* are probably the most suitable.

The internal administration of tablets, &c., containing the lactic ferments, in place of the soured milk, is of questionable utility.

Although some are still sceptical as to the value of soured milk, it can hardly be doubted that it is beneficial in many complaints.[2] Among these are (*a*) those depending on abnormal putrefaction of proteins in the intestinal tract, and including certain cases of acute enteritis and acute and chronic colitis; (*b*) auto-intoxication, with products of intestinal putrefaction, as in many cases of general failure of health in elderly persons, forms of anæmia, neurasthenia, with flatulent dyspepsia, &c.; in minor ailments such as lassitude, headache, some forms of constipation and diarrhœa, rheumatic pains, and the like, benefit frequently results. It must also be recognised that even if the soured milk as such does little good, it often enables an addition of valuable and easily assimilable

[1] *Century Magazine,* November, 1909, p. 56.
[2] Chaterjee, *Ind. Med. Gazette,* September, 1909, p. 329.

[1] "On the Bacteriology of Yoghurt," &c., see Luerssen and Kühn, *Centralbl. f. Bakt.,* Abt. ii, xx., 1908, p. 234; Kuntze, *ib.,* xxi., 1908, p. 737; White and Avery, *ib.,* xxv., 1909, p. 161; Hastings and Hammer, *ib.,* xxv., 1909, p. 419. Full references to the literature of the subject are given in these papers.
[2] Herschel, Proc. Roy. Soc. Med., January, 1910.

food-stuff to be made to the diet by its use. On the other hand, soured milk is by no means a universal panacea, and should not be taken indiscriminately without medical advice, as it sometimes disagrees.

Moreover, the home preparation of soured milk cannot be recommended unless it is undertaken by a member of the household having some knowledge of the scientific principles involved in the practice of sterilisation and use of pure cultures.

R. T. HEWLETT.

CLASSICS AND SCIENCE IN EDUCATION.

THE recent correspondence in *The Times* on the question of "compulsory Greek" at Oxford chiefly refers to academic expediency and the establishment of a *modus vivendi* between the Oxford tradition and the claims of scientific students. But the vital and ultimate question is not this detail of practical politics; it is the question of the fundamental principles of education. The recrudescence of the "Greek controversy" is important, as showing how social evolution is gradually forcing education—however unconscious educationists may be of the fact—along the lines of progress.

The issue at Oxford is between the classical or "literary" test, as a guarantee of the classical or "literary" foundation (or "character," it may be said) of the whole system of Oxford studies, and the interests of "the large body of scientific and other workers to whom literary studies are difficult and tiresome, and to whom the examination in Greek is a mere 'obstacle.'" We quote the words of Prof. Turner; he adds that, in his opinion, "Greek is as important to a literary education as mathematics to a scientific. In neither case is the particular study essential, but it is of vast importance." Dr. Jackson points out that "in many of the university studies the highest proficiency cannot be obtained without a knowledge of Greek. For the highest proficiency in mathematics or any branch of science Greek is not, but modern languages are, a necessity."

In connection with this reference to proficiency, a proposal was recently made that Greek should be retained where it is essential for a complete mastery of the subject, but that where it is not essential an alternative which ensured a certain amount of "literary culture" might be allowed.

Such a test is meant to safeguard the Oxford principle of a "literary" or humanistic foundation for all its studies. With this principle is supposed to be bound up "the Oxford spirit."

If this principle is interpreted to mean that the study of science, for example, should be preceded or accompanied by a training in the arts of language which are necessary for complete power of expression and for the development of that side of the mind which is built up by language, the principle is sound. But if it is made to mean the educational necessity of "culture," in the sense of a literary, rhetorical, or æsthetic habit of mind or refinement of "taste," one must protest. The former has no general applicability to education; it is merely a result of specialising upon literary, rhetorical, or æsthetic material. As for the latter, mental refinement is as much a result of scientific as of literary or classical studies. It is a manifestation of the critical, that is, of the scientific habit.

As a test of this, a general training in science would be at least as effective as the study of a special subject such as Greek. And, to take another point of view, a study of physical phenomena and of their relation to human life and history is essential to both complete mental development and a liberal education. To confuse these last with a "literary" or humanistic tone or curriculum is to confuse general development and general education with specialisation.

Greek is essential to a study of literature or to a complete literary training, but to nothing else. But even supposing that it were necessary for a liberal education, and therefore desirable for scientific students, it is obvious that the standard of Greek required for entrance at Oxford is ludicrously inadequate; it is absolutely no test of anything except of a *beginning* in the study of a particular *language*.

It is as well to be clear on the meaning of the term "literary." As used in this controversy and with reference to the "Oxford spirit," the term implies rather that form of liberal education which consists mainly in a rhetorical philosophy of politics, history, law, and literature than a literary education proper. Even for this form of liberal education a knowledge of the Greek language, however high the standard attained, would not be essential. Greek, as we have said, is only essential to a literary training proper.

Again, whether used for this or for any purpose, it is useless unless it reaches a high standard. To reach such a standard is itself specialisation, and would require so much time that a boy would be unable to learn with any efficiency any other subject. That is to say, he would have to devote to the study as much time as those boys who enter for classical scholarships. Greek, be it understood, implies Latin. The abolition of Latin as well as of Greek is hardly dreamt of as yet.

Prof. Murray, who thinks that the vital point is "the maintenance of both Greek and Latin—but a better as well as an easier Greek and Latin," is assisted by the classical reformers. These are applying new systems, the most important of which is known as the Frankfurt scheme, for the production of better classical results in half the time. Thus, whereas in the old English public-school system a boy took about ten years to attain proficiency, but by no means adequate proficiency, in two dead languages which he never learned to speak, under the Frankfurt scheme, the first three years, say from nine to twelve. are chiefly devoted to obtaining a good grounding in French instead of in the acquisition of Greek and Latin grammar. Then, and not until then, is Latin commenced; Greek is commenced two years later.

On these lines a great deal of experiment is being made in English schools. Much ingenuity is also being shown in methods for quickening and improving the assimilation of Greek and Latin—the oral method, the heuristic, the principle of learning translation from the very beginning instead of after a long training in grammar, and so on. But it is noteworthy that towards the end of the course the classical time-table becomes excessive again.

It does not seem to have occurred to educationists that possibly the only way of learning a foreign language is by speaking it, and that the best results are obtained by learning the vernacular first. There is a further possibility awaiting realisation, namely, that the study of any other language than the vernacular is a case of specialisation. It follows that the imposition of Latin or Greek or French on the curriculum of young boys is at least premature. In time, lastly, we may come to realise that "no man fully capable of his own language ever masters another," or, at any rate, that for the purposes of a general preliminary education or propædeutic (as contrasted with specialisation), not only is the vernacular sufficient if properly taught, but that the learning of another language or languages while the vernacular is in process of formation is so far from being

an aid in this or an assistance to mental development that it is actually mischievous.

The traditionists (for, after all, tradition, whether of the old "learning" or, in more subtle form, of a sort of class prejudice, seems to be the main reason for the retention of classics as a propædeutic) reply that the character of the classical tongues, their inflectional structure and their logical habit, are of great value in the development of the intellect. Instead of asking for proofs of this, we may note the possibility that an efficient study of the vernacular can secure the same results. The Germans (as is shown in a recent report [1]) are beginning to see this. The classicists may quote anecdotes of this or that distinguished man who attributed his lucid and logical English style to his early training in Latin prose, but the same or a better result could be secured in far less time. If the time now given in our schools to classical and modern languages were given to English, the benefits would be enormous both for the general culture of the people and for the special work of specialists, whether in science or languages, in "technical" or "literary" studies. The English taught in schools as yet is a mere parody of what it might be. It is remarkable that the English language does not possess a single text-book of its natural history that can claim any philosophic or scientific importance.

If English were properly taught as the main component of a propædeutic (the other components being elementary mathematics and science, the study of which also needs reorganisation), boys who begin specialisation (for specialisation now perforce begins at school), whether in science or mathematics, would find "literary" studies by no means an obstacle. They would have a command of their own language far in advance of the best classical or "literary" scholar as trained to-day. The result would also be a great benefit to science itself.

The world has already absorbed the Greek "spirit," but it should not forget the fact that the essence of that spirit is the scientific temper. It must also realise that as knowledge increases in bulk there must be periodic sacrifices of what can best be spared. "The wisdom of the ancients" is a phrase which, if not merely sentimental, is absurd. *Antiquitas saeculi juventus mundi.*

Reform is needed in the school curriculum no less than in the university system. If the propædeutic there is on sound principles, there will be no fear of scientific students being without a literary training (and this in the best and most useful direction, the mother-tongue), nor, we may add, will there be any risk of "literary" students being without a scientific training. Greek and Latin will then be reserved for special university courses, just as Hebrew, or rigid dynamics, or forestry may be so reserved, according as the specialist is moved by his own spirit or the spirit of evolution.

A. E. CRAWLEY.

THE CENSUS OF 1911.

THE Census (Great Britain) Bill, making provision for the taking of the census of 1911, was read a first time in the House of Commons on March 4. The Act for the last census, that of 1901, provided that the schedule should require the following particulars, and no others :—"(*a*) the name, sex, age, profession or occupation, condition as to marriage, relation to head of family, birthplace, and (where the person was born abroad) nationality of every living person who abode in every house on the night of the census day; and (*b*) whether any person who so abode was blind or deaf and dumb, or imbecile or lunatic; and (*c*) where the occupier is in occupation of less than five rooms, the number of rooms occupied by him; and (*d*) in the case of Wales or the county of Monmouth, whether any person who so abode (being of three years of age or upwards) speaks English only or Welsh only, or both English and Welsh"—a provision suitably modified in the case of Scotland by a reference to the speaking of Gaelic instead of Welsh.

These requirements have been amplified in the Bill now before Parliament by omitting the limitation to "less than five rooms" in (*c*), so that all occupiers will have to make a return as to the number of rooms inhabited, and by the addition of a new section :—"In the case of any person who so abode being married, the duration of marriage, and the number of children born of the marriage." The first change is of importance, as it will enable the census authorities to give tables covering, more completely than was formerly the case, tenements inhabited by the working classes, and it may be hoped that, in the subsequent tabulation, some distinction as to the ages of persons inhabiting tenements of each given size may be found feasible; a distinction between children and adults would render possible some better indication of overcrowding than the present somewhat crude measure of "more than two persons to a room."

The new section requiring a return, in the case of married persons, as to the duration of marriage and the number of children born of the marriage is of the very highest interest, though its full value will not be reached until the results of later censuses are available for comparison. If the returns are tabulated so as to show the number of children for a given age of mother and a given duration of marriage, it will be possible to compare essentially similar marriages in different districts, and some fresh light will be thrown on the present state of legitimate fertility in this country. It is also to be hoped that a subdivision may be found possible according to the occupation of the father; it would be sufficient to choose a few typical groups of occupations, and it would hardly be necessary to do more than give tables for England and Wales as a whole. Such tables would afford information of the most important kind, which we do not at present possess in any form.

No question is included as to religion, except in the case of the Irish census, for which separate provision is made, and the present Census Bill is very disappointing in that it makes no attempt to place the organisation of the census on a permanent basis or to provide for an intermediate quinquennial census. It is absurd that so important a part of the stock-taking of the nation, as the census is, should be dependent on the chances of party politics, and it is false economy to spend time and money on training a staff for the execution of census work and then to scatter that staff to the four winds—only to go through the process again after a few years have elapsed. A smaller but more permanent staff would be much more efficient and could be fully engaged between one census and the next in the carrying out of supplementary investigations after the publication of the main report. The necessity for the intermediate quinquennial census has been shown again and again, but the statement of the President of the Local Government Board that he is "not without hope that a system of quinquennial census may come to be adopted" cannot be said to carry conviction.

[1] "The Teaching of Classics in Secondary Schools in Germany." (Board of Education Special Reports, vol. xx., 1910.)

ALEXANDER AGASSIZ, FOR.MEM.R.S.

Although the great American oceanographer had reached the age of seventy-five, few of his friends were prepared to hear of his death, which appears to have taken place, somewhat suddenly, on board the s.s. *Adriatic* on March 28, while on a voyage back to the United States.

The distinguished son of a famous father, Alexander Agassiz was born in Switzerland but naturalised in America; yet, so cosmopolitan was he in his tastes and habits, that if ever an individual deserved the title of "a citizen of the world" he was the man. Up to the age of thirteen, he was educated in his native land, but, proceeding to the United States in 1848, he went to the Harvard University, where—as a student in chemistry and engineering—he obtained his degree of B.Sc. at the age of twenty-two. After spending a short time as a member of the United States Geological Survey, young Agassiz became a mining expert, and so successful was he in this profession that, acquiring possession of valuable properties in the Lake Superior region, he rapidly made a very large fortune in connection with the copper mines.

The love of natural-history studies, however, which he inherited from his father, soon made itself felt; at first he assisted his father as curator of the Museum of Comparative Zoology at Harvard. As his wealth increased, he was able to benefit that institution, not only by specimens collected during his extensive travels and by defraying the cost of many expensive publications, but also by gifts of money up to 100,000*l*. After the death of his father he acted as curator of the museum for eleven years. Beginning with the study of marine ichthyology, he subsequently came to be acknowledged as a great authority on the Echinodermata, so that, on the return of the *Challenger* expedition, he was asked to undertake the report on the Echini collected during the voyage.

But the work for which Alexander Agassiz will be chiefly remembered was that which, during nearly forty years, he carried on at his own expense in connection with oceanography. The United States Government, with the greatest liberality and consideration for the interests of science, allowed him from time to time the use of their surveying vessels, the captains of which were instructed to place themselves virtually under the orders of Agassiz himself. The naturalist, aided by a staff selected and paid by himself, carried on soundings and dredgings in every part of the globe, special attention being devoted to the study of coral reefs. Beginning, in 1877, with the study of the Gulf of Mexico, the Caribbean Sea, and the Atlantic coast of America, Agassiz continued his work in 1880 by investigating the surface fauna of the Gulf Stream. Besides working out the details derived from the study of collections made during these voyages, the results of which were published in connection with the Harvard Museum of Comparative Zoology, Agassiz wrote a well-illustrated account of his work, "The Three Voyages of the *Blake*," in two volumes.

In 1891 Agassiz transferred his attention to the western shores of the United States and Central America, investigating the seas around the Sandwich Islands, and paying special attention to the coral reefs there, between 1892 and 1894. His explorations were extended during 1895–6 to the Great Barrier Reef of Australia, and in 1897–8 to the Fiji Islands. In 1899 and 1900 he was able to undertake a cruise among the various groups of coral-islands lying between San Francisco and Japan. In 1901–2 Agassiz commenced his study of the Indian Ocean, paying especial attention to the Maldive Islands and their surroundings; and, in order to complete the examination of portions of the Pacific that he had not already visited, he devoted the years 1904–5 to a cruise among the important island-groups of the eastern half of the Pacific Ocean.

The intervals between his several voyages were occupied by Agassiz in the study of his enormous collections and the preparation of memoirs dealing with the results obtained. These were issued, regardless of expense as to their illustration, in the publications of the Boston Society's Museum of Comparative Zoology. No fewer than thirty volumes of memoirs and fifty-three volumes of bulletins are devoted to the results obtained from the study of these collections by Agassiz and the various specialists who assisted him. His own favourite place of work was Paris, where rooms were always allotted to him in the Museum of Natural History, and he had the fullest access to scientific libraries.

Of the value and importance of the results of these voyages it is impossible to speak too highly. Perhaps the most striking of the conclusions arrived at by him are those relating to great movements which have taken place in the bed of the Pacific in comparatively recent geological times. This is evidenced by the numerous upraised coral-reefs which, following Dana, he described; in many of these the limestone rock, now at elevations of 1000 feet and upwards, has been more or less completely converted into dolomite.

It is not necessary, in face of the above statement of facts, to add that Agassiz was a man of indomitable energy. He thought as little of crossing the Atlantic as we do of crossing the Thames, and death met him at last while still "on the move." Of his courage, a remarkable example is told concerning an altercation he had with a military officer in a crowded restaurant in Germany; on that occasion he did not hesitate to resent an insult by a blow, though fortunately any serious result from the rash act was prevented by the interposition of a number of judicious friends of the officer, aided by American and English visitors who were present. In early life, Alexander Agassiz exhibited something of the dogmatic habit of mind that distinguished his illustrious father; but, mellowed by age and constant intercourse with other men, he became in after life strikingly open-minded and ready to listen to arguments, even those that told against his most cherished convictions. Those who were privileged to enjoy his friendship in his later life knew him as a man of ardent enthusiasm, restless energy, and charming bonhomie, but also as one patient in discussion, and always ready to listen to facts and reasonings from whatever quarter they came. His generosity was unbounded, and he was always ready to place his abundant materials at the service of young men who were qualified and willing to engage in their study.

In every scientific circle of Europe, as well as in those of America, Alexander Agassiz was well known, and in all of them his loss will be deeply mourned. In France he received the Légion d'Honneur, and in Germany the Order of Merit. In this country he was for many years a Foreign Member of the Royal Society. Only last year the Royal Geographical Society awarded him the Victoria research medal, and we may fitly conclude this notice with the verdict of the president in announcing the award—a verdict in the justice of which all must agree—"He has done more for oceanographical research than any other single individual."

John W. Judd.

NOTES.

THE Oceanographical Museum at Monaco was inaugurated last week by the Prince of Monaco in the presence of a gathering of more than two hundred representatives of Governments, of scientific institutions, and of oceanographical research. Among many others present were:—M. Loubet, ex-President of the French Republic; M. Pichon, French Minister of Foreign Affairs; Admirals of the Fleet von Koester from Germany and Grenet from Italy; Vice-Admiral de Jonquières, commanding the French Mediterranean Squadron; and distinguished representatives of the Governments of Spain and Portugal. The Institute of France sent a large body of members representing the Academies of Sciences and of Fine Arts. The Academy of the Lincei at Rome, the Academies of Sciences at Berlin, Vienna, and St. Petersburg, the Royal Societies of London and Edinburgh, the Geographical Societies of Paris, Berlin, Vienna, and St. Petersburg, the Challenger Society, and many other societies and institutions were amongst the societies sending delegates. The British Government was not represented officially, owing to some blunder, but Mr. W. E. Archer, of the Board of Agriculture and Fisheries, Mr. J. Y. Buchanan, F.R.S., Dr. G. H. Fowler, Prof. W. A. Herdman, F.R.S., Dr. J. Scott Keltie, and Dr. H. R. Mill represented British marine studies. Among the leading men connected with oceanography, marine biology, and kindred sciences in other countries there were Mr. Bendall, of Bordeaux; Prof. Drygalski, of Munich; Prof. Forel, of Lausanne; Senator Grassi, of Rome; Prof. Haeckel, of Jena; Dr. P. P. C. Hoek, of Haarlem; Prof. Hensen, of Kiel; Prof. Hergesell, of Strassburg; Dr. Knipovitch, of St. Petersburg; Prof. Krümmel, of Kiel; M. de Margerie, of Paris; Prof. Otto Nordenskjöld, of Gothenburg; Prof. Penck, of Berlin; Prof. Perrier, of Paris; Prof. Pettersson, of Stockholm; Dr. Schmidt, of Copenhagen; Dr. Schott, of Hamburg; Prof. Supan, of Breslau; Prof. Thoulet, of Nancy; Prof. Max Weber, of Amsterdam; and Dr. Richard, director of the new museum, with Profs. Berget, Joubin, and Portier, of the Oceanographical Institute in Paris. The museum was inaugurated by the Prince of Monaco at a grand function on Tuesday, March 29; on the following day there was a banquet to three hundred guests, and the evenings were occupied by a special performance at the famous Opera House in Monte Carlo, a display of fireworks of extraordinary brilliance in the harbour, and finally by a magnificent State reception in the gorgeous apartments of the ancient palace of the Grimaldis. Meetings of four commissions, on the Atlantic, on the Mediterranean, on the perfecting of the Oceanographical Institute, and on the bathymetrical chart of the world, were held under the presidency of the Prince, and a summary of the proceedings will appear in another issue of NATURE. The Prince conferred the Order of St. Charles in four classes on a number of persons, amongst whom may be mentioned as receiving that of the second class, or commander, Mr. J. Y. Buchanan, Senator Grassi, Prof. Penck, and Dr. Richard. The princely hospitality displayed on the occasions extended to the provision of free hotel accommodation for all the visitors invited to the *fêtes*, while the representatives of States were entertained at the Palace as personal guests of the Prince.

SIR WILLIAM RAMSAY, K.C.B., F.R.S., has been nominated president of the British Association for the meeting to be held at Portsmouth next year.

SIR HARRY JOHNSTON, G.C.M.G., has been elected a corresponding member of the Italian Geographical Society, in recognition of his work in Africa.

WE regret to see the announcement of the death, at eighty years of age, of Prof. E. Pflüger, professor of physiology at the University of Bonn, and director of the Physiological Institute there.

THE council of the Institute of Metals has decided to initiate what is hoped will be an annual series of May lectures. The first of these will be given in London on Tuesday, May 24, when Prof. W. Gowland, F.R.S., will deliver a lecture on "The Art of Working Metals in Japan."

A REPORT from Berlin states that Prof. Abegg, of the University of Breslau, was killed as the result of a balloon accident on April 3. Prof. Abegg was president of the Silesian Aëronautic Society, and a prominent figure in the German aëronautic world.

WE learn from the *Chemist and Druggist* that M. Henry Giffard, who died at Paris in 1882, made the State his residuary legatee. By a recent decree the Minister of Public Instruction placed a sum of 4000*l.*, being part of the legacy, at the disposal of the University of Paris for the foundation of an Institute of Radio-activity.

AT to-morrow's meeting of the Royal Astronomical Society, Prof. P. Lowell is expected to be present, and will speak upon his work. Major-General H. P. Babbage will exhibit and describe a calculating machine which he has recently completed, corresponding to the portion of the analytical engine which his father, the late Charles Babbage, named "The Mill."

A REUTER telegram from Berlin states that an expedition will leave Bremerhaven on July 1 on board the North German-Lloyd steamer *Mainz* for Spitsbergen in order to investigate the possibilities of an airship flight to the North Pole, which is planned for the summer of 1912. The party will include Prince Henry of Prussia, Count Zeppelin, and Profs. Hergesell and Drygalski, and will number altogether twenty-four members.

THE valuable collection of shells formed by the late Mr. Thomas Gray, a well-known Glasgow conchologist, who died recently at the advanced age of eighty-nine, has been left by him to Kelvingrove Museum, Glasgow. More than 7000 species of shells are represented in the collection, including both British and foreign, land, fresh-water, and marine forms. It is said to be the finest collection of its kind in Scotland, and its possession places the Kelvingrove Museum well abreast of the leading museums in this country.

AN Industrial and Agricultural Exhibition will be held at Odessa from May 15 to October 1 of this year. During the exhibition there will be lectures on technical and scientific subjects, and arrangements are being made for some congresses. The cooperation of scientific men is invited by the committee of the exhibition (Odessa, Novoselskaja 4, Technische Gesellschaft).

THE Civil Service Commissioners announce that, in addition to the open competitive examination for situations as cartographer in the Hydrographic Department of the Admiralty, which is to be held in July next, another open competitive examination for similar situations will be held in December. Forms of application for admission to the December examination will be ready for issue about the middle of July, and will then be obtainable on request, by letter, addressed to the Secretary of the Civil Service Commission, London, W.

MR. F. G. OGILVIE, C.B., has been appointed by the 'resident of the Board of Education to a new post of ;ecretary of the Board for the Science Museum, Geological Museum and Geological Survey. Mr. E. K. Chambers ıas been appointed to succeed him as principal assistant ecretary of the technological branch of the Board. Dr. I. F. Heath, director of special inquiries and reports, has een appointed to the post of principal assistant secretary f the universities branch of the Board in combination with iis present post.

MR. WALTER RUNCIMAN, President of the Board of Education, has appointed a departmental committee to onsider and report upon various questions in regard to the resent condition and the future development of the valuıble collections comprised in the Board's Science Museum t South Kensington and Geological Museum in Jermyn Street. In particular, the committee is asked to advise im (*a*) as to the precise educational and other purposes vhich the collections can best serve in the national nterests; (*b*) as to the lines on which the collections hould be arranged and developed, and possibly modified, o as more effectively to fulfil these purposes; and (*c*) as o the special characteristics which should be possessed y the new buildings which it is hoped will be erected hortly on the South Kensington site to house these collecions, so as to enable the latter to be classified and exhibited n the manner most fitted to accomplish the purposes they re intended to fulfil. The committee is as follows:—Sir Iugh Bell, Bart. (chairman), Dr. J. J. Dobbie, F.R.S., ir Archibald Geikie, K.C.B., P.R.S., Dr. R. T. Glazerook, F.R.S., Mr. Andrew Laing, Sir Schomberg IcDonnell, K.C.B., Sir William Ramsay, K.C.B., '.R.S., Prof. W. Ripper, Sir W. H. White, K.C.B., '.R.S., with Mr. F. G. Ogilvie, C.B., as secretary.

REUTER messages from Catania record that the eruption f Mount Etna increased in violence up to the end of Iarch, when a stream of lava was moving at a speed of early forty yards an hour in the direction of Cisterna .egina, near Borrello. On April 4, however, the activity ad considerably lessened. The streams of lava had minished in volume, and changed their direction. They ere then flowing towards Monte Rinazzi and Monte aggi, submerging the lava remaining from previous uptions. There was a pronounced recrudescence of the uption early on April 5. The lava stream flowing wards Cisterna Regina in particular increased its rate progress to 10 metres an hour, and reached a spot only ;o metres distant from the Nicolosi Borello road, destroyg the cultivated land on its course.

THE summary of the weather for the first three months the present year, just issued by the Meteorological ffice, shows that the mean temperature was above the erage over the entire kingdom. The rainfall was below e average in the north of Scotland, and in agreement ith the average in the north-east of England, whilst in l other districts the fall was in excess of the average; e greatest excess was 2·77 inches, in the north of Ireland. ıe largest total measurement was 14·61 inches, in the rth of Scotland, and the least 5·21 inches, in the east England. The number of rainy days were everywhere excess of the average. There was an excess of sunine over the whole of Great Britain, amounting to hours in the Midland counties, 76 hours in the northst of England, and 70 hours in the south-west of ıgland. The largest aggregate duration of sunshine for three months was 362 hours, in the Channel Islands, and the least 212 hours, in the north of Ireland. There was an excess of sunshine in twelve out of thirteen weeks in the Midland counties, and in eleven out of thirteen weeks in the south-west of England.

MR. R. M. BARRINGTON, writing from Fassaroe, Bray, Co. Wicklow, says:—"On March 21, at 9 a.m., the reading of the wet-bulb mercurial thermometer 4 feet from the ground in a Stevenson's screen was 1° F. *higher* than the dry-bulb mercurial thermometer 3 inches distant in the same screen, the readings being 46° and 45° respectively. Assuming the instruments are accurate and in working order, can such a thing occur?" He adds that at the moment of observation the temperature was falling rapidly. A distinguished meteorologist informs us that cases of the wet bulb above the dry are by no means rare, but the difference is rarely so much as 1°. They are generally dealt with in practice by attributing the differences to instrumental errors or temporary meteorological circumstances (such as the rapid fall of temperature noted by Mr. Barrington), which bring out an imperfection in the conventional methods of thermometry.

THE tragedy which deprived M. Charlois of his life on Easter Day deprived French astronomy of a brilliant worker and the Nice Observatory of an enthusiastic observer. M. Charlois devoted himself chiefly to the minor planets, and was only second to Dr. Max Wolf in the number of these bodies which he discovered. At the foundation of the Nice Observatory by M. Bischoffsheim in 1881, Charlois was appointed secretary to M. Perrotin, the first director, and in 1887 was given charge of the minor planet work. Observing with the 38-cm. refractor he discovered, up to December, 1902, 104 which previously had escaped detection. Twenty-seven of these were found visually, between 1888 and 1892; but M. Charlois was the first to adopt Dr. Wolf's photographic method, and thereby added seventy-seven more asteroids to the rapidly growing family. These he discussed in vol. viii. of the Annals of Nice Observatory, but he also published a number of orbits, observations, &c., in the *Bulletin astronomique*, the *Astronomische Nachrichten*, &c.; for this work he was awarded the Janssen medal of the Astronomical Society of France in 1899. Minor planets did not, however, absorb all M. Charlois's energies, for he observed many comets, measured double stars, made a great number of latitude observations, and accompanied M. Thollon to Spain for the transit of Venus in 1882. At the transit of Mercury in 1907, he made observations which afforded corrections to the ephemeris, and he also rendered valuable assistance to the International Astrographic Conference in their work on Eros; it is interesting to note that he secured a plate showing the trail of this remarkable asteroid on the same evening that it was discovered by De Witt, but did not recognise it until after the announcement of the discovery by the Berlin observer.

LITTLE has hitherto been known of the language of the Yana tribe of Indians, who occupy part of Shasta County, in the northern region of California. This want has now been supplied by Messrs. E. Sapir and R. B. Dixon, who have contributed to the ninth volume of the Publications of the University of California a series of legends recorded from the lips of the two last survivors of those learned in the tribal traditions. One of these tales is a remarkable variant of the Prometheus type of legend, describing how Fox, Sandpiper, and Coyote stole the fire, how the world was burned, and how the thieves escaped in a basket which Spider hauled up to heaven by his thread. Another and less complete version of the tale has been published by Mr.

J. Curtin in his "Creation Myths of Primitive America." The present collection of tales, recorded in two dialects, will preserve for the use of philologists a language which is fated before long to disappear.

The group Mesozoa is, as is well known, a kind of zoological waste-paper basket into which various obscure forms of extremely lowly organisation have been cast from time to time. Many of these forms are of great interest as indicating possible transitions from the unicellular to the multicellular condition. The genus Haplozoon has been added to this miscellaneous assemblage by Dr. Dogiel, who describes some new species thereof in the *Zeitschrift für wissenschaftliche Zoologie* (Band xciv., Heft 3). These remarkable parasites, which live in the alimentary canal of various polychæte worms, occur in the form of single or multiple chains of cells, the first cell of the series being provided with one or more stylets. Dr. Dogiel has proposed the group-name Catenata for these organisms, which he considers to be derived from the unicellular Peridinea, and to exhibit protophyte rather than protozoon affinities.

In a paper on the stability of the physiological properties of coliform organisms (*Centralbl. f. Bakteriologie*, Abt. ii., Bd. 26, 1910, S. 161) Mr. Cecil Revis suggests that the capacity of a micro-organism to ferment various sugars, polyhydric alcohols, and polysaccharides depends on the presence of certain atomic groups in the substances. Thus glucose, mannose, galactose, lævulose, and lactose all contain the group —CHOH—O—CH=, and are fermented by *Bacillus coli*, while sucrose does not, and is not fermented by many strains of *B. coli*. Attempts were made to change the fermentive properties of various strains of *B. coli* and other organisms by prolonged sojourn in soils contaminated with fæces, &c., and in a non-albuminous medium. After some months changes were frequently noticed in the organisms isolated. Thus with one typical *B. coli* which fermented lactose, dulcitol and glucose well in twenty-four hours, after seven months in soil contaminated with human fæces an organism having the original properties was isolated, and, in addition, three other forms, A, B, and C, were isolated, characterised by differences in the appearance of their colonies. Of these, A and C gave the original reactions unchanged, but B fermented none of the test substances. Other instances of similar changes are given. In control cultures kept on gelatin, in general no change at all occurred.

The Municipality of Hanover, according to a paper by Mr. E. Howarth on some German museums in the February number of the *Museums Journal*, deserves the gratitude of antiquarians for having restored and fitted up as a museum Leibnitz House, the picturesque fifteenth-century residence of a German merchant. It contains four storeys, all stocked with objects of industrial art and industry, arranged from an æsthetic rather than a systematic point of view.

In the March number of the *Irish Naturalist* Mr. R. J. Ussher gives his experiences of cavern-exploration in Ireland, in which he has taken so large a share. Most important of all is the mammoth-cave near Doneraile, Cork, which was worked from 1904 onwards, and is older than any other except Shandon. This cavern takes its name from the number of mammoth-remains, but is also characterised by the abundance of reindeer and the absence of red deer, wild boar, and badger.

According to the report of the Lancashire and Western Sea-fisheries (to which allusion was made in a recent issue), there is reason to believe that black-headed gulls are injurious to cockle-beds. In the Floodborough district these birds have been ascertained to feed almost exclusively on young cockles, which they pick out of the sand. It is accordingly recommended that these birds should be excluded from the Wild Birds Protection Act, and their eggs destroyed in the breeding-season.

In the course of an interesting account of his recent journey in north-western Arabia, published in the March number of the *Geographical Journal*, Mr. Douglas Carruthers claims to be the first European who has sighted the Arabian ostrich since Palgrave's time. Three were seen in the Wadi Hidrij, about 120 miles south-east of the Dead Sea, which is probably the northern limit of these birds, the range of which includes all the interior of Arabia. It is suggested that the Arabian ostrich is inseparable from the typical *Struthio camelus* of North Africa, but since the Arabian oryx and baboon are distinct from their African relatives, this is by no means certain, and can only be determined by the acquisition of actual specimens. Mr. Carruthers states that the interior of Arabia is undergoing secular desiccation, so that many of the Beduin find it increasingly difficult to maintain themselves.

The question of the proper pose of the limbs of Diplodocus, which was opened some months ago by Dr. Hay, has been taken up again by Mr. G. Tornier in a paper published in the *Sitzber. Ges. naturfor. Berlin*, 1909, p. 193. In this paper a restoration is given of the skeleton, in which the shoulder-girdle is pushed low down and the humerus and femur are extended almost horizontally, so as to bring the belly within a very short distance of the ground, while the head and neck are raised aloft in swan-like fashion, the feet being mounted in wholly plantigrade style. The general appearance of the skeleton is somewhat grotesque. On p. 507 of the serial cited Mr. Tornier replies to those who have criticised his restoration of Diplodocus. Prof. O. Abel (*Verh. k.k. zool. bot. Ges., Wien*, 1909, p. 117) has likewise entered the lists, and urges that all the sauropod dinosaurs were "elephant-footed," that is to say, in place of being plantigrade, their feet were of the semi-digitigrade type characteristic of the Proboscidea, with posterior foot-pads. This Mr. Tornier refuses to admit in a paper published in the *Sitzber. Ges. naturfor., Berlin*, 1909, p. 537, where the completely plantigrade character of the feet of these reptiles is re-asserted.

Mr. B. H. Ransom, assistant-custodian of the helminthological collections, the National Museum of Washington, has written a valuable work on the tænioid cestodes of North American birds (Bulletin No. 69, U.S. National Museum, Washington, 1909). Ten years ago, when studying under Prof. H. B. Ward, at that time of Nebraska, he began an investigation into the cestodes of North American birds, and the present volume, of 140 pages, is the first outcome of this research. The volume contains detailed descriptions of five new species, and there are numerous adequate figures. It also contains keys to the genera of the superfamily Tænioidea, diagrams of families, subfamilies, and genera, and lists of the species occurring in North American birds are added. The recent monograph of Dr. O. Fuhrmann, the well-known authority on bird tape-worms, has been of great service to the author. Mr. Ransom's paper ends, as is usual with American publications, with a very full bibliography and an accurate and full index, for which we cannot be too grateful to the author.

Dr. K. M. Levander has published an important work on the food and parasites of fishes in the Gulf of Finland ("Beobachtungen über die Nahrung und die Parasiten der Fische des Finnischen Meerbusens," *Finnländische Hydro-*

graphisch-Biologische Untersuchungen*, No. 5, Helsingfors, 1909), supplementary to the earlier works of Dr. G. Schneider. A work of this kind requires very careful analysis and abstracting, and if we are to learn which of the species forming the food has supplied the parasites in question, we must carry the research rather farther. We have n this work very long lists of species of insects and their arvæ, of Crustacea and their larvæ, of molluscs, occasional worms, and other fish all eaten as food. We have also considerable lists of cestodes, trematodes, nematodes, Acanthocephala, &c., but the paper does not, in our opinion, sufficiently attempt to indicate which food-animal brought nto the body of the fish the several parasites enumerated. Nevertheless, the work forms a foundation for further investigation, and one which will afford material for a greatly developing subject.

The spread of interest in ecological botany is naturally creating a demand for photographs and lantern-slides of ypical areas of vegetation. Mr. W. B. Crump, of Halifax, who has taken part in some of the British botanical surveys, has accumulated a series of photographic negatives

(b)

Calluna Heath : a Cheshire Mere. (*a*) *Molinia coerulea*; (*b*) *Juncus supinus.*

epicting many of the recognised plant associations, from hich he offers permanent photographic prints (15 by 12 iches or 12 by 10 inches) made by the ozobrome process or antern-slides. The more detailed studies are only offered s lantern-slides. Descriptive notes are supplied. The hotograph reproduced represents a Cheshire mere, near ne margin of which clumps of *Molinia coerulea* are growing, while heather is seen in the immediate foreground, and plot of *Juncus supinus* occurs on the further side.

The first issue of the *Kew Bulletin* (1910) opens with a escriptive list, communicated by Mr. G. Massee, of new xotic fungi. An agaric, *Marasmius scandens*, so called om the way it extends its cord-like mycelium and produces the resupinate pilei at intervals, is reported to cause onsiderable damage to cocoa plants on the Gold Coast. wo suspected insect parasites are described, viz. *Sclerorris gigaspora*, taken on orange leaves with scale insects, nd *Septocylindrium suspectum*, found on the bodies of dead frog-hoppers." A new parasite on the roots and branches of *Hevea brasiliensis*, received almost simultaneously from Singapore and the Gold Coast, receives the name of *Diplodia rapax* (Melanconiaceæ). Mr. A. D. Cotton contributes an article on the growth of the alga *Ulva latissima*, which, in contrast to most algæ, flourishes in stagnant and sewage-polluted water.

Messrs. J. B. Baillière et Fils are issuing a small monthly booklet, *Le Mois agricole*, containing notes likely to be of value to the agriculturist, the vine-grower, and the gardener. There are also detailed notices of the recent publications of the firm.

The necessity for continued work on the sugar-cane is thoroughly recognised in the West Indies, and bulletins are regularly issued setting forth the results obtained up to the time of publication. We have recently received Pamphlet No. 63 of the Imperial Department of Agriculture for the West Indies, giving a summary of the results obtained in Antigua and St. Kitts during 1908–9.

The Agricultural and Horticultural Association issue an annual booklet entitled "One and All Gardening," containing a number of short articles of interest to gardeners and others. Among the most attractive is one by the Hon. H. A. Stanhope, in which the legends attached to certain plants are pleasantly re-told. The outdoor school lessons given at the Frensham Schools in Surrey are described, while Miss Sipe writes on school gardening in the United States. The booklet is well illustrated.

From the Edinburgh and East of Scotland College of Agriculture we have received a bulletin, by Dr. Lauder and Mr. Fagan, giving the milk records for the dairy herd at the Rosslynlee Asylum. An attempt was made to trace the relation between ventilation of the cow-sheds and the yield of milk, but the results are not very decisive. So far as they go, they indicate that the animals in the well-ventilated, and therefore colder shed, gave at least as much milk as those in the warmer, ill-ventilated sheds, and remained in a healthier condition.

A report has recently been issued by Mr. E. Brown on the poultry industry of 1909, from which it appears that the decline in the import of foreign eggs, which has been going on since 1903, still continues, not so much as a result of increased home production as of increased requirements by Germany, now the largest importer of poultry produce in the world; but although the amount of our imports has declined, the values have risen, and the factors at present controlling prices seem to be permanent. It is urged that farmers and small holders have now an opportunity in connection with poultry raising such as they never have had before.

In vol. lii., part iv., of Smithsonian Miscellaneous Collections, Mr. G. P. Merrill describes and figures a stony meteorite which has recently come into the possession of the U.S. National Museum at Washington. The interest

of this specimen, which is of rudely quadrangular form, with a maximum diameter of about 2½ inches, consists in the fact that it was actually seen to fall by the late Mr. B. F. Wilson on October 15, 1888, in McDuffie County, Georgia. It fell within a distance of about thirty yards of the observer, who was engaged at the time in picking cotton, and was at first under the impression that someone had thrown a stone at him. The meteorite buried itself to a depth of some 6 or 8 inches in the soil.

An application of the hydrodynamical theory of seiches to the Lake of Garda (Benaco) forms the subject of an essay by Dr. Francesco Vercelli (*Memorie del R. Istituto Lombardo*, vols. xxi.–xxii. [3], 1). The form of the lake is very irregular, the lower end being divided into two branches by a rock forming the peninsula of Sirmione, and projecting for a considerable distance further under water. The author has calculated the positions of the various nodes, and has applied Chrystal's so-called "quartic approximation" to determine the periods of the various oscillations. On comparing these with limnographical observations made at Desenzano, a good agreement has been obtained, while the formulæ of Merian and of Du Boys are stated not to have led to the same satisfactory conclusions.

The ordinary form of liquid bath for the determination of melting points has been modified by the introduction of an air-bubble system, causing a rapid circulation of the liquid, and hence a uniform temperature. The same idea has been very ingeniously applied by Mr. H. Stoltzenberg (*Zeitschrift für physikalische Chemie*, March 11) in designing a low-temperature cooling bath. The liquid (pentane) is caused to circulate by means of hydrogen bubbles through a spiral dipped in liquid air, ether, and solid carbon dioxide, or a mixture of ice and salt, according to the temperature required, and then passes into the vacuum-jacketted vessel in which the measurements are carried out. The temperature can be easily regulated by altering the amount of the spiral immersed, and can be kept very constant.

In the *Annalen der Physik*, iv., 30 (1909), Dr. M. Laue discusses the question of thermodynamic reversibility as applied to diffraction of light through a grating. The question has assumed a new aspect since the investigation of the properties of coherent pencils has shown that regular reflection and refraction at the surface of two media is not essentially irreversible. The conclusions at which Dr. Laue arrives are fairly simple and straightforward. If an indefinitely extended train of plane light waves falls on an equally indefinitely extended grating no irreversible change takes place. On the other hand, if the grating is limited in extent the measure of the irreversible changes, in terms of entropy, is equivalent to that produced by diffraction through an aperture equal in size to the grating itself. Thus the larger the area of the grating the less entropy change is associated with the diffraction, and every intermediate condition exists between the practically reversible diffraction of a very large pencil of light and the irreversible diffraction of a small one. In the *Physikalische Zeitschrift*, x., pp. 807–10 (1909), Dr. Laue enunciates analogous conclusions. He finds that the scattering of light by small transparent particles is irreversible, and that if diffraction at a grating is accompanied by absorption the change of entropy is the same as if the absorption were associated with an equivalent geometrico-optical process. We have here a simple illustration of the futility of formulating a thermodynamical scheme on the dQ/T definition of entropy. At the same time, the principle of coherence does nc render it possible to produce an increase of availabl energy, but only to rescue what would otherwise be lost and this is not inconsistent with a broader enunciation c the laws of thermodynamics.

Messrs. G. Philip and Son, Ltd., have issued a plani sphere of the earth (price 7*s.* 6*d.* net), devised by Mr. G. F Morell, by which it is possible to determine, with a singl adjustment, the local time corresponding to any give Greenwich time, or *vice versa*. The whole surface of ou globe is projected upon a disc about 23 inches in diameter capable of rotation about a point fixed at the North Pole Parts of this disc show through a circular window abou 13 inches in diameter on the face of the planisphere, an around this window the hour lines are marked, so tha the relation between the meridians on the map of the eart and the time can be seen at once. About three years ag the same publishers produced a "Standard Time-dial," i which the north and south hemispheres of the earth wer mounted back to back and rotated together on a singl pivot (see Nature, October 31, 1907). The planisphere nov issued serves the same purpose, and while it has th advantage of enabling the relation between the times a any parts of the world to be seen at a single glance, i suffers from the disadvantage of great distortion in th case of regions south of the equator. For the consideratio of relative times this distortion does not matter, though i would be misleading if used for purposes of geographica instruction, and it enables believers in a flat earth to shov that all the phenomena of local time can be explained o their theory. The diagrams of constellations inserte around the circular opening convey a completely wron impression as to the relation of the stars to the earth but while the planisphere will be of little value education ally, it provides a very convenient means of determinin easily the corresponding standard times at any instant i different parts of the earth.

The first edition of Prof. J. Percival's "Agricultura Botany" was published by Messrs. Duckworth and Co ten years ago, and was favourably reviewed in thes columns (vol. lxii., p. 570). The work has been accepte as the standard text-book for agricultural students an others concerned with practical aspects of botany, and w are glad to welcome the appearance of the fourth edition A new chapter has been added on the Linacæ, with par ticular reference to flax or linseed; and among the addi tions is an account of Mendelian laws of inheritance, t which much experimental work has been devoted sinc the original volume appeared in 1900. The book nov contains about twenty more pages than the first edition and the revision and additions will enable it to maintai the high position it holds among text-books for the study laboratory, and the reference book-shelf.

A comprehensive catalogue of important works o mathematics, astronomy, physics, chemistry, and kindre subjects is comprised in the first part, just issued, of th supplement to Messrs. H. Sotheran and Co.'s "Bibliothec Chemico-Mathematica." The notes to many of the work are both interesting and curious, and they make this cata logue a readable publication instead of merely a list o titles of books.

Messrs. Watts and Co. have issued for the Rationalis Press Association, Ltd., a cheap reprint of Prof. Haeckel' "Last Words on Evolution." The price of the nev edition is sixpence in paper covers and one shilling boun in cloth.

OUR ASTRONOMICAL COLUMN.

OCCULTATION OF MARS, APRIL 13.—An occultation of Mars by the moon will take place at 10.28 p.m. on April 13, the planet disappearing behind the dark limb of the moon in position-angle 0°. Emersion will take place at 11h. 4m. p.m. in position-angle 278°, the angle in each case being reckoned from the zenith point of the moon towards the east.

COMET 1910*a* AND HALLEY'S COMET.—From an article by Mr. Knox Shaw, published in No. 40 of the *Cairo Scientific Journal*, we learn that photographs of comet 1910*a* were secured at the Helwan Observatory. The comet was first seen ten minutes after sunset on January 20, clouds having prevented earlier observations. The Reynolds reflector was not ready for photographing objects at such low altitudes, but some good photographs were secured with a 4-inch Cooke lens on January 24, 25, 27, and 28; more cloudy weather then intervened. The photographs show the twin tails and also the southern secondary tail, which is much fainter, and can only be traced to a distance of 40′ from the head.

Mr. Shaw also publishes a useful diagram of the path of Halley's comet, with regard to the sun and the earth, during the period February 1 to May 29. A photograph of this object, obtained at Helwan on January 28, showed faint traces of a tail about 18′ in length.

Three excellent photographs of 1910*a*, and one of Halley's comet, appear in No. 1, vol. iv., of the Journal of the Royal Astronomical Society (Canada). They were taken at the Dominion Observatory, Ottawa, on January 25, 28, 31, and February 10, respectively. On the last-named date the negative of Halley's comet showed a tail ½° long.

A brief message from M. Jean Mascart informs us that he is at Teneriffe, where, at an altitude of 2700 metres, he intends making observations of Halley's comet. M. Mascart's station is very near that occupied by Piazzi Smith during his sojourn, for astronomical observations, in the island.

SUN-SPOTS AND FACULÆ IN 1909.—Prof. Ricco's usual annual summary of the sun-spots and faculæ observed at Catania during 1909 appears in the February number of the *Memorie di Astrofisica ed Astronomia* of the Società degli Spettroscopisti Italiani (vol. xxxix., p. 17). On the whole, the activity displayed during 1909 was markedly less than that of 1908. In April, 1909, there was a sudden decrease of spots, the mean frequency becoming 2·5 instead of 4·1 as it was in March. This low value continued for six months, but in October there was a renewal of activity, the mean frequency again rising to 4·3, a value which it maintained until the end of the year. Thus, although the quarterly values of the frequencies were 4·1, 2·4, 2·3, and 4·3 respectively, the half-yearly values were more nearly equal, at 3·1 and 3·2, the latter also being given as the mean frequency for the whole year. The frequency values for faculæ vary in the inverse to those of spots, the quarterly values being 1·2, 1·4, 2·1, and 1·2; the mean for the year is 1·6.

THE NATURE OF COMETS' TAILS.—In the course of an article on the present position of the problem of the formation and constitution of comets' tails, which appears in the *Physikalische Zeitschrift* for March 15, Dr. L. Zehnder revives and extends a theory he first put foward twenty-six years ago in the pages of *Kosmos*. According to this theory, as the swarm of meteorites which constitutes a comet approaches the sun, the meteorites nearer the sun begin to give out gases and vapours which arrange themselves as atmospheres about single or about groups of several meteorites. These atmospheres refract the light from the sun, and, according to their densities, concentrate the sun's rays to foci at different distances behind themselves. If a meteorite is present at a focus it may be rendered visible, or even be heated sufficiently to produce combustion of any hydrocarbons present in it. The meteorites thus heated surround themselves in turn with atmospheres which concentrate the sun's rays on still more remote meteorites, and the visible tail of a comet is, according to the theory, the locus of the successive foci. Dr. Zehnder considers the forms of the refracting atmospheres which would produce the various types of tails now known.

PERIODIC ERRORS IN RIGHT ASCENSION OF STANDARD STAR CATALOGUES.—A comparison of the periodic errors of the right ascensions of the Newcomb, Auwers, and Boss standard catalogues is published by Dr. Downing in No. 420 of the *Observatory*. The comparisons were made with the "Standard Mean Right Ascensions of Clock Stars for 1900·0, based on Twelve-hour Groups," published in the Greenwich "Second Nine-year Catalogue," the places there given being, presumably, free from periodic errors depending upon right ascension.

The differences found are very small in amount, but most interesting in their distribution. There is a distinct drop at R.A. 4h. and a rise at R.A. 20h. which are too persistent, throughout the catalogues, to be entirely due to accidental errors. It is suggested that the peculiar distribution of magnitude through R.A. may account for some of, but not all, the discordances in question.

OBSERVATIONS OF SOUTHERN DOUBLE STARS.—The first number of the Circular of the Transvaal Observatory is devoted to the measures of a number of double stars discovered by Mr. Innes, with the 9-inch Grubb refractor, south of declination −19°. Experience shows that this instrument, used at the altitude (5900 feet) of the Transvaal Observatory, is capable of resolving very close doubles (0·3″) discovered by Prof. Hussey with the 36-inch refractor at Lick, and 11 per cent. of the 268 stars (Innes, 433–700) now given are separated by not more than 0·5″; 43 per cent. have distances of 1·0″ or less. Mr. Innes also gives a list of stars which have been wrongly identified by other observers.

THE "GAZETTE ASTRONOMIQUE."—We regret to learn from the current number of the *Gazette Astronomique*, published by the Antwerp Astronomical Society, that, until further financial support is forthcoming, this very useful journal for amateur astronomers will only be published alternate months, instead of monthly, as heretofore. The *Gazette* always contains ephemerides, notices of phenomena, &c., in addition to interesting accounts of observations; the subscription is 3 francs per annum, post free.

AURORAL DISPLAYS.

BRILLIANT displays of aurora were reported from many different parts of Scotland on the nights of March 27, 28, and 29, and aurora was also observed in Ireland and the northern portion of England. At Aberdeen aurora was seen each night between 8 and 9 o'clock. The *Westminster Gazette* gives an account of a brilliant display seen at Edinburgh early on the morning of March 28, stating that two separate displays were seen before 2 a.m., and there was a third shortly before 2.30 a.m. One of the first indications of the coming of this third display was a long, luminous shaft stretching upwards and intersecting the constellation Cassiopeia at a point near the star δ Cassiopeiæ. For some seconds it remained motionless and alone, like the tail of a great comet. Then the sudden flashing forth of a myriad quivering shafts and sheaves of light, exquisitely and delicately tinted, outlined a wide arch of striking beauty.

Mr. Wilfred C. Parkinson, writing from Eskdalemuir Observatory, Scotland, gives the following interesting details of the display on March 28:—

8.10 p.m.—Luminous band first observed in N. rising slowly like a bank of light cloud.

8.14–8.38.—Gradually assuming a curved form 10°–12° above horizon at middle point, which was rather to the W. of N., and about 8° in width. Length about 140°.

8.40.—Band very bright and well defined, very intense at top edge, gradually thinning out towards the lower edge.

8.53.—The lower edge of the main band had formed a distinct band by itself, running parallel to the higher band, but not so wide, long, or intense. Higher band of uniform intensity throughout.

8.54.—Vertical streamer gradually forming, and also smaller ones, fluctuating in length and brilliancy.

8.56.—Vertical streamer very intense, especially where the curved bands cross it.

8.59.—Lower horizontal band gradually disappearing. Upper band growing faint and ill-defined. Vertical streamers growing more numerous.

(A most marked feature after 9h. was the way in which the streamers formed in the north and moved in a procession towards the west.)

9.8.—Lower band entirely gone. Upper band still visible, but faint. Numerous vertical streamers forming and intersecting the horizontal band.

9.16.—Horizontal band had entirely disappeared. Vertical streamers had increased in numbers and intensity. Constant fluctuations in brilliancy until 9.28, when last streamer had disappeared.

Mr. S. L. Elborne, writing from Peterborough, reports that on March 28, about 6 p.m., he saw a magnificent display of parhelia or mock suns, lasting about twenty minutes; on each side of the sun, and at equal distances from it in the same straight line, and parallel with the horizon, appeared a brilliant spot displaying the colours of the spectrum in the centre of each, giving the effect of three suns setting simultaneously; from each arose a luminous band, thus making a splendid arch over the true sun.

THE PUBLIC HEALTH OF THE METROPOLIS.[1]

THIS report abounds in information of great interest to all who have at heart the well-being of the metropolis. The first part relates almost exclusively to vital statistics, the second to public health administration, and the third part contains much instructive matter upon school hygiene.

The year 1908 was a very exceptional one for London so far as vital statistics are concerned, for the marriage-rate (15·9), birth-rate (25·2), and death-rate (13·8) were the lowest ever recorded. The death-rate has shown a decline for the past forty years, while in the case of the birth-rate the fall year by year has been slight, but uninterrupted, for some thirty years. What this decline in the death-rate of a population of 4,795,757 persons implies is very forcibly expressed in terms of "life capital." By this expression is implied the years of life saved to the community by a reduction in the death-rate. The number of lives saved at each age period (as calculated by comparing the number of deaths for the year, in each age period, with the mean death-rates for those age periods for ten years, and crediting each life saved with the years representing the expectation of life at that age) represented a saving of 26,205 lives, and a gain to the community of 1,066,770 years of "life capital." The highest corrected death-rates were furnished by the City of London, Finsbury, and Bermondsey, and the lowest by Hampstead and Lewisham.

The infant mortality rate was lower in London for the last decennium than in all save one of the thirteen other large English towns; and London had a lower figure for 1908 than any of those towns. This fact, as Sir Shirley Murphy, the Medical Officer of Health, states, is matter for congratulation, though, as he adds, it needs to be remembered that the infant mortality rate is liable to considerable fluctuation, owing to climatic conditions and varying degrees of prevalence of epidemic maladies. There are notable differences in the rates of infant mortality in districts well and badly circumstanced socially, a fact which sufficiently indicates the results which might be obtained if the infants of the less favoured districts had extended to them the same care as that bestowed upon infants of the better favoured districts. Among metropolitan boroughs the loss of infant life has for several years been greatest in Shoreditch and Bermondsey, and least in Hampstead.

The infant mortality rate is, of course, affected by the administrative efforts made to reduce it, but the rate is so extremely sensitive to other influences, which vary from year to year, that the value of this work cannot be judged by the mortality of the moment. Among systematic efforts now being made in the metropolis for the preservation of infant life, Sir Shirley Murphy commends the system of visitation by health visitors, and he points out that the Notification of Births Act, 1907, which is such a valuable measure for enabling this work to be undertaken most advantageously, had in 1908 been adopted in all but eight boroughs. In some districts official workers were supplemented by a staff of voluntary workers supplied by local health societies.

During the year 1908 the lowest death-rate from the epidemic diseases was recorded. No death occurred from small-pox, and the deaths from measles, whooping-cough, diphtheria, enteric fever, diarrhœa, and phthisis were below the averages of the last ten years, but those from influenza and scarlet fever were above the averages.

The London vaccination returns give food for thought and apprehension. As legislation has made it more and more easy to obtain exemption from vaccination, the unvaccinated children would be expected to increase. The latest returns recorded are those for the year 1906, when the percentage of unvaccinated children was 21·2, as against 26·4 in 1896, 7·8 in 1886, and 6·5 in 1876. There can be little doubt that the percentage of exemptions for the past three years will, when these are available, demonstrate a considerable increase. A notable feature in the behaviour of enteric fever in London in recent years has been the manifestation of localised prevalence occurring in poor populations and lasting often for a considerable number of weeks. There were two such prevalences in 1908, one in Bethnal Green and the other in Shoreditch, and Dr. Hamer furnishes, in an appendix, a full report on these two outbreaks.

Special reference is made to results obtained by Dr. Sidney Davies from the voluntary notification of zymotic diarrhœa among infants in Woolwich in the months of July, August, and September. Dr. Davies is of opinion that the infection spreads from person to person, and he thinks the distribution of the cases is consistent with the hypothesis that the disease is conveyed by flies. An examination of the statistics contained in his inquiry shows that while infants who are breast-fed suffered much less than those artificially fed, there is not much difference between the incidence of attack on children fed on cow's milk and those fed on condensed milk—except among the children fed on cow's milk at the Infants' Milk Depot, who suffered much less than other infants artificially fed.

The phthisis death-rate for 1908 was the lowest ever recorded. It amounted to 1·32 deaths to every 1000 persons living during the year. In dealing with phthisis the Medical Officer comments upon the work done in connection with the voluntary notification system in operation in twenty-one London boroughs in 1908, and he refers to the Order of the Local Government Board requiring notification of cases of phthisis in London which occur in Poor Law practice. London is, however, as the medical officer points out, but very imperfectly provided with the opportunities which are needed for utilising the knowledge thus gained. Phthisis mortality occurs especially among the poor, and measures for its reduction must not only include sanatoria and hospitals, but also those which afford assistance not only to the sufferer, but often to the families which are dependent upon him. It is here that the extension of philanthropic effort is greatly needed.

For the purpose of enabling the incidence of cancer on the several populations of the London sanitary areas to be more precisely stated, factors have been calculated for correcting the death-rates, so far as possible, for the differences in the age and sex constitution of the several populations compared. When these allowances are made it is found that in the year 1908 St. Pancras (1·17) had the highest rate, and that the lowest obtained in Fulham (0·79).

The question of nuisance from flies in connection with deposits of house refuse and stable manure has again been dealt with on lines similar to those followed in 1907, and the observations form the subject of another appendix to the report. In 1907, as in 1908, the large part played by collections of horse manure in determining fly prevalence was abundantly apparent, and the need for regulating the sanitary condition of stables was thus again emphasised.

On July 1, 1908, the administration of the General Powers Act, 1907, part iv., was brought into operation, and from that time until the end of the year 620 samples of milk were taken, principally from churns at the large railway stations. Of the samples in which it was found practicable to make a complete examination, 11·6 per cent. were found to be tuberculous. The farms supplying the

[1] Report of the Public Health Committee of the London County Council, submitting the Report of the Medical Officer of Health of the County for the Year 1908. (London: P. S. King and Son.) Price 3s. 6d.

samples giving positive results were inspected by the council's veterinary inspector; 4997 cows in all were examined, and of these 147 were found to present tuberculous udders. Provincial local authorities have shown willingness to cooperate with the council in preventing the sale of milk from cows which the council's veterinary inspector has certified to be suffering from tubercular disease of the udder, and in a few instances veterinary inspectors have been appointed by the local authorities to deal with this danger.

The report by Dr. Kerr upon the medical work of the council, as the education authority, deals with a period for the twenty-one months ending December 31, 1908. This period has been marked by great activity in all matters concerning school hygiene and the physical care of children. There are, in the opinion of the medical officer, further and wide-reaching changes in prospect. He states:—"Any public provision for protecting and aiding growth and development of children during the years of school life—three to sixteen years of age—should be entirely committed to the Education Authority. This would allow such matters as feeding, teaching, cleansing, medical treatment, or social protection of school children, when these duties become a public care, to be administered by the one authority, and by bringing all the various problems into a correct relation and perspective would also effect considerable financial economy. On the other hand, transient conditions in which the child bears the same social relations as any other individual, as for instance when affected with typhoid or scarlet fever, or when guilty of a crime, would still come under the same provision by the Sanitary Authority or Police respectively as at present. Fortunately this is the line taken by all the recent legislation in matters concerning children."

The educational work of the county council which falls under the direction of a medical officer is very extensive, embracing the examination of candidates for employment and scholarships; medical inspection of school children, including the inspection and the hygienic condition of school premises, &c.; a large amount of work to promote cleanliness and to prevent communicable disease; and prescribing the special school work amongst the scholars in schools for the mental or physically defective, the blind or deaf, &c. The medical staff at the end of 1908 numbered fifty-two, and it has been decided to increase the staff by the addition of sixteen school doctors in the summer. The school nursing staff consists of a superintendent, two assistants, and fifty-one school nurses; these undertake the oversight of personal hygiene in both elementary and secondary schools. Upon the subject of underfed school children, the medical officer directs attention to the fact that there is no certain criterion of this condition, and it seems often quite impossible to distinguish between bad feeding, improper feeding, and bad home conditions. The treatment of those children in whom medical inspection discovers defects has received a great deal of consideration at the hand of the county council. A solution has not yet been arrived at, but it is certain that visual troubles, discharging ears, ringworm, and conservative dentistry are matters on which neither the private practitioner nor the hospitals can give sufficient or satisfactory relief, and the establishment in London of school clinics to deal with these conditions amongst school children will probably be the eventual solution. The work of the school nurses was almost entirely directed to effecting the cleansing of scholars' heads, bodies, and clothing. Nearly twenty thousand children are known to the nurses as uncleanly in these respects. That such conditions are tolerated gives an idea of the conditions of the homes, which are often so dirty and dark, and wanting in the means of cleansing, that it would be an injustice to exclude such children and prosecute the parents. It appears that the municipal cleansing stations provided for cleansing verminous persons are inadequate to deal with all these cases. The Children's Act, 1908, gives power to the education authority to examine and cleanse these children in default of the parents, and it looks as if that authority will have to make some provision for dealing with these cases, at least in some parts of the metropolis.

The open-air schools provided by the council (four in number) are doubtless doing a great service, physically and educationally, to children with ailments which unfit them to take their place in the school class-room with the ordinary scholars. Children with scrofulous and tuberculous conditions, anæmia, adenoids and enlarged tonsils, heart disease, and certain bone, nervous, and eye diseases, profit considerably by a few months in these open-air schools.

PROBLEMS OF THE SOUTH-WESTERN HIGHLANDS.[1]

THE southern Highlands of Scotland consist of a complex series of gneisses, schists, crystalline limestones, and quartzites, trending across Scotland approximately from south-west to north-east. These metamorphic rocks are bounded abruptly to the south by the Highland boundary fault, which brings them against Upper Palæozoic rocks. Their northern boundary is less regular, and is generally the junction with the Moine gneiss, the rock which occupies so much of the Northern and Central Highlands. The schists and the associated rocks between the Moine gneiss and the boundary fault may be conveniently grouped together, under the name proposed by Sir Archibald Geikie, as the Dalradian system.

The most important difficulty in the interpretation of these rocks is the uncertainty as to which is the upper and which the lower end of the succession. According to Nicol, the southern members are the youngest, and there is a descending series to the north. This view is contradicted by many obvious facts in the field geology, and the view is therefore widely held that Nicol's order must be reversed, and that the beds of the southern margin are the oldest. One serious difficulty in the second view is that the southern rocks are much less altered than the northern, and this theory therefore involves some measure of selective metamorphism. Several ingenious interpretations have been advanced to overcome this difficulty. The author of the address, however, held that both views as to the order of succession are correct in parts. For convenience of reference, the Dalradian system may be divided into five series, which, with their relations to the other pre-Cambrian rocks, are shown in descending order, as follows:—

<table>
<tr><td>Algonkian</td><td colspan="3">Torridon Sandstone</td></tr>
<tr><td rowspan="2">Dalradian</td><td>Main sequence</td><td colspan="2">On Southern Margin</td></tr>
<tr><td>(5) Schichallion Quartzite
(4) Blair Atholl Limestones and Black Schists and interbedded Quartzites
(3) Ben Lawers series
(2) Loch Tay Limestones and associated garnetiferous mica schists
(1) Loch Lomond Gneiss</td><td>Age ? Upper Dalradian or later</td><td>Aberfoil Slates and Grits
Ben Ledi Schistose Grits</td></tr>
<tr><td>Caledonian</td><td colspan="3">Moine Gneiss and associated schists</td></tr>
<tr><td>Lewisian</td><td colspan="3">Lewisian Gneiss</td></tr>
</table>

This classification adopts Nicol's succession in part, as it accepts the Aberfoil and Ben Ledi series as younger than the Loch Lomond gneiss, against which they rest, and it is consistent with the less altered condition of the southern rocks and the steady diminution in the metamorphism of the rest of the rocks going northward, as, for example, from the Loch Lomond Gneiss to the Loch Awe Grits, and from the garnetiferous mica schists of the Loch Tay series to the black schists and unfoliated quartzites near Blair Atholl.

The evidence in some points of this succession is still incomplete, especially as regards some of the rocks within easy access of Glasgow. The special points on which

[1] Abstract of the Presidential Address delivered to the Glasgow Geological Society, by Prof. J. W. Gregory, F.R.S.

further research would be most useful were therefore mentioned in the hope that the members of the Glasgow Geological Society would investigate them.

The problem is of interest from its bearing upon the early geological history and geography of north-western Europe. The structure of western Europe has been dominated by the formation of three great mountain systems, each due to pressure usually from the south, and each having its younger rocks exposed mainly on the northern flanks of the chain. The youngest is the Alpine system, formed mainly in Upper Cainozoic times, and including the Pyrenees, Alps, Carpathians, &c. A somewhat similar mountain system, of which fragments remain in southern Ireland, Devonshire, Brittany, and Germany, had been formed in Upper Palæozoic times; from its analogy with the Altai Mountains of Asia, Suess has called its mountains the European Altaids. Still earlier, in later Archæan times, there was formed the first of these European mountain systems, of which fragments occur in northern Ireland, the Grampians, and Scandinavia. There are many interesting analogies between these old Grampians and the later Altaids and Alps. The old mountain system to which the Grampians belonged probably extended far westward into the North Atlantic, and to its influence may be attributed the desert climate of Scotland during the deposition of the Torridon Sandstone.

THE ETIOLOGY OF LEPROSY.

THE eighteenth report of the Board of Health on leprosy in New South Wales contains the usual careful clinical records of the features of the disease in the patients admitted during the year, as well as a record of all the cases occurring in the Commonwealth during 1908. No case of leprosy has ever been heard of in Tasmania. In the other States the disease occurs apparently most frequently in Chinese and in aboriginals, and is more frequent in northern than in southern territories.

An account is given of a systematic test of Prof. Deycke's "nastin" treatment. Nastin is a vaccine made from a leptothrix found in some recent Lepromata, and not from the bacillus lepræ. It is pronounced valueless, any beneficial result being assigned to the natural fluctuations in the progress of the disease; one or more cases of spontaneous cure are noted. For the rest, the report is remarkable for the scepticism the author, Dr. J. Ashburton Thompson, expresses on the etiology of leprosy and on the value of isolation as a preventive of transference of the disease.

It will be remembered that the International Congress at Bergen last year endorsed the view that the bacillus lepræ of Hansen was the etiological agent. Dr. Thompson's views are seemingly published as a protest, and, holding the views he does, it is gratifying to learn that Dr. Thompson recognises that, as the presiding and executive member of the central health authority to which the Leprosy Act is entrusted, he has a clearly defined duty to perform, and that he performs it, notwithstanding his thinking "the *mère idée* on which that law is based to be of doubtful utility," and his statement, "I can at all events safely assert that its validity has not been demonstrated." One would have thought that the success which has attended the practice of isolation in Norway during the past forty years afforded sufficient evidence of its value even to the most sceptical, for Hansen's prophecy some forty years ago that in 1920 there would be no leprosy in Norway is in more than a fair way of being fulfilled.

HELIUM IN AIR AND MINERALS.

AN interesting paper on the occurrence of helium in the air of Naples and in minerals from Vesuvius is published by Prof. A. Piutti in the *Rendiconto* of the Royal Society of Naples (third series, vol. xv., p. 203). It is well known that in 1881 Prof. Palmieri read a paper before the same academy in which he claimed to have recognised the characteristic line D_3 of helium in the flame spectrum obtained by heating in a Bunsen flame "an amorphous, buttery substance of a yellow colour which was found as a sublimate on the edge of a fumarole near the mouth of Vesuvius." This is generally accepted as the first discovery of terrestrial helium, although Nasini and Anderlini in 1906, on examining the flame spectrum of a large number of volcanic incrustations, failed to recognise the presence of helium in any of the specimens they examined under the conditions described by Palmieri.

Prof. Piutti has now investigated with especial care, and by an ingenious method, the gas evolved on heating several Vesuvian minerals. The gas was expelled by heating the mineral in a quartz tube connected, through a three-way cock, with a Plücker tube, a Gaede air-pump, and a glass bulb containing cherry-stone carbon, which could be cooled to −192° C. The latter served to absorb nitrogen and inert gases other than helium. All air was first entirely removed from the apparatus by the Gaede pump, special care being taken to ensure its complete absence prior to heating the mineral and during the course of the experiments. When the carbon is cooled by liquid air and the vacuum applied, any nitrogen present is first absorbed by the carbon, and the lines of argon and neon appear until the kathode space is formed. At this point, if even the smallest trace of helium is present, the D_3 line is seen distinctly by the side of the sodium lines. Control experiments showed that 0·073 cubic mm. could be detected in the apparatus employed. Helium can also be detected in the same way in 3·5 c.c. of ordinary air.

The examination of several radio-active forms of sanidinite from Vesuvius showed that the radio-activity was due to particles of zircon contained therein. This zircon was found to evolve helium, and other samples of zircon from different localities, Italian and otherwise, were also found to contain helium in varying proportions. No relation could, however, be traced between the proportion of helium and the radio-activity or density of the samples. The Vesuvian zircon had the highest radio-activity, but the proportion of helium was relatively low.

THE SUGAR INDUSTRY IN HAWAII.[1]

HAWAII and its associated islands, Maui, Oahu, Kauai and others, form a volcanic group in the Pacific 20° north of the equator, largely devoted to sugar production. In 1895 the Sugar-planters' Association established an experiment station at Honolulu, and some five years later the islands were annexed by the United States. The enormous importance of these two events is reflected in the statistics for sugar production :—

	Hawaii	Maui	Oahu	Kauai	Total	
1895	61,643	27,735	17,433	42,816	149,627	tons
1896	109,259	29 097	35,782	51,650	225,828	,,
1900	115,224	57,347	53 625	63,348	289,544	,,
1901	134,618	58.349	99,534	67,537	360,038	,,
1905	126,405	100,434	123,095	76,314	426,248	,,
1908	180,159	122,629	137,013	81,322	521,123	,,

The increase during the fourteen years has been from less than 150,000 tons to more than 520,000 tons, and detailed statistics show that the produce per acre, as well as the total acreage, has increased.

Practically all phases of the sugar industry are dealt with at the experiment station. Varieties of canes are tested, seedlings are raised and examined, and the effect of change of variety is investigated, the object being always to obtain plants more prolific, better adapted to the local surroundings, and more resistant to the local diseases or insect pests than those at present grown. Considerable attention is paid to insect pests, which naturally do an increasing amount of damage as cultivation becomes more and more intense. Methods of working up the sugar are also studied, the chemical and milling problems involved are gone into, nothing within the power of the staff and likely to benefit the planters being omitted.

In consequence there is a constant tendency to economy in production; thus in the early years fertilisers were often applied without any reference to the specific requirements of the crop or the general deficiencies of the soil; now, however, these, and also climatic considerations, are taken into account, and the staff are able to give useful definite information as to the mixture of fertilisers required.

[1] Tropical Life, No. 2, vol. vi., 1910. Bulletins of the Sugar-planters Associations, Hawaii.

Relatively large quantities of nitrogenous and of potassic manures are found necessary, phosphates being less needed; to meet this demand, potash salts and nitrate of soda are now imported in quantity. Ten years ago there was practically no importation of these manures.

A certain amount of the land has to be irrigated, especially that occurring on the leeward side of the high land forming the interior of the island. On the windward side, however, the rainfall is higher and irrigation is not necessary. On the island of Hawaii itself most of the plantations are unirrigated, but on the other islands irrigation is very general. Here, also, useful help has been given by expert engineers in ascertaining the cheapest effective way of obtaining the necessary water.

NATURAL SCIENCE IN BENGAL.

THE annual report of the Asiatic Society of Bengal for the year 1909 has now been published. We notice that the society celebrated its 125th anniversary on January 15, 1909. The celebration took the form of an evening reception held in the Indian Museum. Many scientific, archæological, philological, and historical exhibits were shown, illustrating the progress and activities of the society. The council awarded the Barclay memorial medal for 1909 to Lieut.-Colonel David Prain, F.R.S., I.M.S. (retired), in recognition of his biological researches.

The total number of contributions to the society under the heading mathematics and the natural sciences was seventeen. Commenting on these, the report points out that Mr. Hooper's paper on *Tamarisk manna* shows that the chief sugar in it is not mannite, but a saccharose. Babu Bidhu Bhusan Dutta, in a contribution on the constituents of the roots of *Arisaema concinnum*, Schott, and *A. speciosum*, Mart., shows that these two famine foods contain much nutriment, chiefly starch. Mr. B. L. Chaudhuri directed the attention of the society to the mosquito-larvæ eating propensity of fish of the genus Haplochilus, and asked for cooperation in making further observations. Several species of this genus of small fishes are voracious feeders on the larvæ.

Babu Nibaran Chandra Bhattacharjee directed attention to the way in which *Marsilia quadrifolia* fruits only when the water in which it has been growing recedes from it and leaves it dry. Mr. H. Martin Leake's paper on Indian cottons is of importance. His object is to breed early cotton suitable for cultivation at Cawnpur, with the good lint of the slow-maturing cottons; he has observed the characters in bud development which lead to early or late maturity in order to recognise such as combine with the desirable quantities in the lint. Mr. E. P. Stebbing, in a paper on the Loranthus parasite of the Moru and Ban oaks (*Quercus dilatata*, Lindl., and *Quercus incana*, Roxb.), shows how destructive the parasite is to these oaks in the neighbourhood of Naini Tal and in Kumaon. Sir George King's "Materials for a Flora of the Malayan Peninsula" has been continued. Accounts of the orders Gesneraceæ, by Mr. H. N. Ridley, and Verbenaceæ, by Mr. J. Sykes Gamble, have been received. Mr. Burkill has diagnosed two varieties of the lemon oil grass, *Cymbopogon Martini*. Prof. P. Brühl has contributed a paper on recent plant immigrants into Bengal; 234 species are named by him; their origin is discussed and the causes of their introduction. America supplied 54·7 per cent. of these immigrants.

THE DEVELOPMENT OF ELECTRICAL POWER AT NIAGARA FALLS.[1]

THE development of electrical power at Niagara Falls has long attracted widespread attention and interest. Since the first installation upon the American side, descriptions and discussions of its works and methods have been granted a conspicuous place in technical records and the scientific Press, but the fact is apparently less known that there now exist at Niagara four more installations, each larger than the pioneer plant, and one at least differing from it to a very marked degree in the method in which the turbines are employed and coupled to the electrical generators.

The author, having paid a visit to Niagara in December, 1907, when exceptional opportunities were afforded him of inspecting the whole plant of the Ontario Power Company, takes the present opportunity of recording the following notes, which may supplement the knowledge of the subject hitherto available, especially so as, after the completion of these notes, correspondence took place with the Ontario Power Company with the object of eliciting further information, and photographs were received illustrating the operations of the company.

Scheme.—Briefly outlined, this company's development comprises the taking of water from the Upper Niagara River above the Horseshoe Fall, leading it through pipes and penstocks to turbines in a station below the Fall, and there utilising its energy for the generation of electricity, which is transmitted to a second station on the hill above, and thence distributed. There is a fall in level of 55 feet in the rapids above the Horseshoe Fall, and to take advantage of this the headgates are placed just above the rapids. From the headgates three great steel and concrete tunnels or conduits, laid below the surface of the Victoria Park, will convey nearly 12,000 cubic feet of water per second to the top of the cliff above the power-house, and just beyond the Fall. Thence it will pass through twenty-two steel penstocks in shafts and tunnels down and out through the cliff to an equal number of horizontal shaft turbines in the power-house below, which is situate on the water edge immediately at the foot of the Horseshoe Fall. From the generators, the electrical cables will pass through tunnels to the twenty-two banks of switches, transformers, and instruments in the distribution station on the hill above, and thence to the transmission lines beyond, the whole installation, when complete, being capable of an output of more than 200,000 horse-power.

The intake works for the entire 200,000 horse-power are now finished. One of the three main conduits is completed and in use, while the portals and headworks for the second and third tunnels are completed, and a portion of the excavations made. Six of the twenty-two penstocks are completed, and with their turbine-sets are at work, and at the time of the author's visit the seventh was practically completed. The distribution-station building is complete for the switchboard of the entire twenty-two units, for the transformers of eight, and the other apparatus of fourteen units, and is well ahead of the developments in the power-house.

The most important engineering features wherein this latest company differs from its predecessors are the arrangement of intake works, the design of main conduit and spillway, the horizontal shaft turbine units, the symmetry of arrangement of the whole, the centralisation of control, and the protective isolation of the various apparatus.

Particulars of Niagara River and the Falls.—The total drop in the Niagara River in its course of thirty-six miles between Lake Erie and Lake Ontario is 326 feet, of which 216 feet is in the Falls and the rapids immediately above them.

The American Fall is 167 feet high and 1000 feet in width, while the Horseshoe Fall is 159 feet high and 2600 feet in width. The greatest depth of the river immediately below the Falls is about 192 feet. It is estimated that an average of 222,400 cubic feet of water pass over the Falls each second. This is 25,000,000 tons per hour, or about one cubic mile a week, and represents a kinetic energy of nearly 5,000,000 horse-power. At the headworks of the Power Co. the river is 3400 feet wide, and flowing at an average velocity of about 8 feet per second.

Intake.—These works have been placed and designed, not only to take advantage of the additional height of the rapids as mentioned above, but also with special reference to the ice difficulties, which have been the limiting factor in the success of Niagara power. Cake-ice in enormous quantities floats down for weeks at a time from the Great Lakes, and mush-ice is also formed in the rapids, primarily by the freezing of spray and foam, and secondarily by the disintegration of cake-ice. The latter trouble is avoided, since the intake is in the smooth water just above the

[1] From a paper entitled "An Account of a Visit to the Power Plant of the Ontario Power Co. at Niagara Falls," read before the Institution of Mechanical Engineers on January 7, by Mr. C. W. Jordan.

rapids at a place where the current is very swift. To exclude the former trouble, the following precautions have been taken:—a long and tapering forebay, protected at the entrance by the main intake, terminates at its narrow down-stream end in a deep spillway. Upon the river side it is enclosed by a submerged wall, while the other side, near the spillway, is occupied by the main screen building leading to the inner bay and to the portals and headgates of the three conduits.

The intake, which is nearly 600 feet long, stretches across the inlet at Dufferin Island almost parallel with the current in the river. Throughout its whole length, a concrete curtain wall extends down 9 feet into the water, which is 15 feet deep at this spot, so that the gate openings beneath admit only deep water, and this at right angles to the swift exterior surface flow, which, sweeping the full length of the curtain wall, carries the floating ice past to the rapids beyond.

The intake is divided into twenty-five bays, through to the inner bay, and parallel with the direction of flow in the outer bay. Here again a curtain wall formed by the front wall of the superstructure admits only deep water to the screens at right angles to the main current, while it also excludes ice with the surface currents maintained through the forebay by a huge spill of surplus water. At the gate structure, where the water is 30 feet deep, the tapering portals leading to the electrically operated Stoney headgates are protected with wide-meshed screens, which are also enclosed and safeguarded by a curtain carried by the front wall of the gate-house. There is an ample ice-run from the bay in front of the curtain to the river, and both at the headgates and screens an open canal spills into a gravity ice-run emptying into the river. Both buildings are supplied with steam for heating and thawing from an underground boiler plant, and the author can testify to the entire success of the heating. It was a bitterly cold day, snowing and freezing hard, with a nasty wind, but inside these houses it was almost unpleasantly hot, in

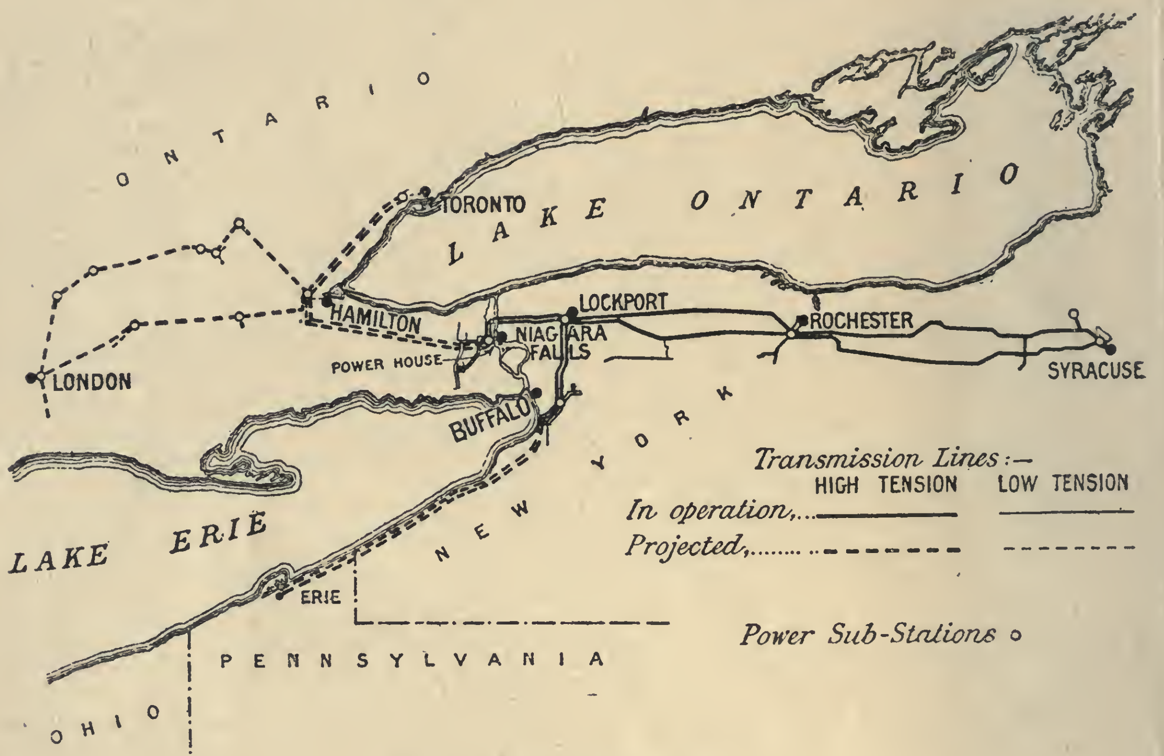

Fig. 1.—Power District of Niagara Falls.

which the water is admitted at a velocity of 5 feet per second. Provision is made for inserting stop-logs into each of the twenty-five openings in order to regulate the flow of water.

The outer forebay has an area of 8 acres, and a depth ranging from 15 to 20 feet, and is bounded on its down-stream side by a submerged wall or dam 725 feet long, terminating at the down-stream end of the screen-house, which is 320 feet long, built of reinforced concrete faced with Roman stone.

The inner forebay is 2 acres in area with a depth of 20 to 30 feet, whilst the gate-house, similar in construction to the screen-house, is 120 feet long and divided into six bays, two for each of the main conduits. The 18-foot "Stoney" gates which guard the entrances to the conduits weigh 18 tons each, or 36 tons including the counter-balance. They were built by Ransomes and Rapier, and are operated by electric motors of 5 horse-power capacity.

At the main screen the same precautions for the exclusion of ice are repeated. This structure, which is 320 feet in length, in 20 feet depth of water, lies across the entrance spite of the large masses of ice-cold water coming in continuously from the river. The water before entering the conduits must pass through three automatically selective steps, each excluding ice, and, in addition, through two screens, each behind ice-runs, in heated buildings containing live steam for emergencies, and the experience of three winters has proved the above plan of excluding and preventing the formation of ice to be an entire success—a record which is unprecedented for power plants in a climate like that of Niagara.

An electric overhead travelling-crane runs along the screen-house for removing the screen-frames for cleaning and changing when necessary, and as this building is situate in the park the roof is flat and finished off as a promenade, access being obtained from the outside by broad steps at either end of the building, and from this point a magnificent view of the upper rapids is obtained.

Main Conduits.—These are of 0·5-inch rivetted and reinforced steel embedded in concrete 18 feet and 20 feet in diameter and 6500 feet long, sunk beneath the surface of the park. The water flows through them at an approxi-

mate velocity of 15 feet per second. The only conduit at present in service has a sectional area of 254 square feet, and is capable of supplying sufficient water for the operation of six generators at full load. The second and third conduits have not as yet been installed. Just beneath the top of the cliff, behind the power-house, is a long underground chamber 274 feet long, 10 feet high, and 16 feet wide, with an arched concrete roof to support the conduit above. Rivetted to the bottom of the main conduit are seven large tapered steel castings leading to the 9-foot valves and penstocks below, each supplying water at 10 feet per second to a single horizontal shaft turbine in the power-house below.

Spillway and Weir.—The spillway at the end of the conduit, which is intended to prevent water-hammer in the case of sudden loss of load, is little more than the enlarged end of the main conduit, raised and fitted with an enclosed weir and underground discharge. The weir is adjustable as to height, and the discharge tunnel, after a steep initial pitch in the taper from the weir, follows a uniform grade and symmetrical curve while circling about to reach the river in a helix, thus preserving a water column which is smooth and unbroken, of highest velocity and least expenditure of energy. This has the effect of preventing erosion, restricted flow, and excessive air-suction, the latter on account of the danger of ice forming from the spray under forced circulation of air.

Location of Power-house.—The power-house is situated on the river bank nearly at water-level and close under the Horseshoe Fall, and it is an interesting and important point that the full head of water between the upper and lower rivers has been acquired so far as was possible from an economic standpoint, while the huge and costly excavations rendered necessary in the previous schemes have also been dispensed with, resulting in a greatly reduced capital expenditure.

Owing to limited space, the generating station is only 76 feet wide, but when completed it will be nearly 1000 feet long; the generating units stand side by side in a single row right down the centre of the building, the turbines being on the land side and nearest their source of supply. The space between them and the rear wall is occupied by a gallery, upon which are mounted the oil-pressure governors, each almost over the end bearing of the turbine it controls.

The mean water-level at the generating station is 343 feet above tide, though it varies from 338 to 365 feet. The walls of the generating station are of concrete, the rear wall being 12 feet thick at the bottom and the river wall 9 feet.

Generating Units.—Each generating unit consists of a horizontal double turbine direct coupled to a generator. The completion of the station and its equipment will be but an extension of the present form until, according to present plans, there will be an installation under the one roof, capable of continuously delivering 200,000 horse-power of electrical energy. Three of the generators, which are all of the conventional horizontal shaft pattern and exactly alike in appearance, have a capacity of 10,000 horse-power each, while the others have each a capacity of 12,000 horse-power. These machines are wound for three-phase current at 12,000 volts and 25 cycles, and have revolving fields, the revolutions being 187·5 per minute. The total weight of each generator is 231 tons, and each was entirely assembled on the spot, including the building up of the laminated iron rotor and the winding and insulating of the armature.

Turbines.—The turbines were made by J. M. Voith, Heidenheim, a. d. Brenz, Germany, and are of the Francis or inward-flow type, double, central discharge or balanced twin turbines, and are designed to deliver 12,000 horse-power at 175 feet head. Their shafts are 24 inches maximum diameter, and each carries two 78-inch cast-steel runners of "normal" reaction. The housings are of reinforced steel plates 16 feet in diameter, spiral in elevation, and rectangular in plan. Gates are of the wicket or paddle type, and the rotating guides forming them are carried by shafts which project through stuffing-boxes to an external controlling mechanism worked by the governors, thus freeing the casings from the objectionable internal-gate rigging, and leaving the approaches to the guides uniform and open. Whilst the velocities in housings and draft-tubes are high, corresponding losses are avoided by easy changes of velocity and direction, and large curves free from acute angles or obstructing projections.

Leads.—The leads from the generators are single conductors, insulated with treated cambric. These leads, each in a separate compartment, are mounted on porcelain insulators, ample clearance to earth being allowed everywhere; the compartments are built up of thin shelves of reinforced concrete fastened to the concrete substructure of the power-house, and are closed by asbestos doors readily removable for inspection. At no place are the leads of more than three generators brought near one another, and the leads of each set of three generators, where they approach their respective oil-switches on the gallery, are so protected and isolated from each other that earths or short circuits are impossible. Field circuits, exciter leads, and control wires are carried in iron conduits, and are either in separate passages or at a proper distance from the main wires.

Distributing Stations.—The generating and distributing stations are parallel, and nearly 600 feet apart, with a difference of 260 feet in elevation. The distributing station is wider and shorter than the power station, and is divided into three longitudinal bays or five main sections. The narrow front bay contains the switches, bus-bars, &c., at generator pressure; the wider rear bay contains those at transmission pressure. Between these bays is the main middle bay, divided transversely by a three-floor switchboard section into two long transformer-rooms. The projecting central bay is utilised as offices. The transformers stand along the centre of the two rooms in groups of three, corresponding in position and capacity to their respective generators. Similar apparatus is arranged in rows parallel with each other and with the generating units. Unit values corresponding to the generators in capacity and position are maintained throughout. Thus each generating unit has its individual cables, switches, and switchboard, section of bus-bars, transformers, interrupters, and high-pressure switches complete to the transmission lines, enabling independent operation as an independent power plant, or, through the selector switches, and duplicate sectional bus-bars, the operation of all units in any combination of groups, as readily and perfectly as their operation in parallel.

Transformers.—The low-pressure bay contains on the main floor the 12,000-volt automatic oil circuit breakers in double column, and in the chamber beneath only the sectional duplicate bus-bars and their immediate connections. In the transformer-rooms the transformers stand in pits 6 feet below floor-level, and parallel with them, adjacent to the high-pressure bay, are corresponding pits for choke-coils or other protective apparatus. Beneath, and between the foundations, are laid the various systems of piping for water, oil, and drainage, and the main cable-ways to the transformer above. Each transformer is fitted with a recording thermometer, and is of the oil-insulated, water-cooled type, three to a unit, connected in delta on the low voltage, and in star with centre grounded on the high-voltage side. The secondary potential of each transformer is 36,000 volts, and, as connected, the resultant line voltage is approximately 62,000 volts. Each transformer has a normal capacity of 3000 k.v.a., and weighs, complete with oil and case, approximately 50 tons. They are cylindrical in form, and the three constituting a unit are arranged in a triangular group in the pit.

Recording Instruments.—The graphic recording instruments are of a new type, and comprise voltmeters, ammeters, wattmeters, and frequency and power-factor indicators. They are so connected in the low-voltage circuits that there is a continuous record of each generator as well as of the demands of any set of feeders. In the control-room, the chief operator's position is in the centre, where at his desk he may observe, by means of his instruments, every electrical occurrence, and direct his assistants as required. He has his own private telephone system running to all the rooms in the building, and also has direct connection with telephones along the transmission wires. The telautograph is invariably used for communicating with the generating station, because of its un-

mistakable records. The chief operator is thus able, without moving from his chair, to control every electrical circuit and situation of the system, and to stop, start, regulate, or synchronise each unit. He can throw the output of each unit through its transformer to the transmission as if from a single isolated plant, or he can throw the current upon either bus-bar while supplying its transformers from the same or another bus-bar. The experience obtained up to the present in the practical working of the plant has been so successful that it is to be anticipated that other large plants in the future will adopt the same system.

Distribution of Power by the Ontario Power Co.

Two 60,000-volt lines run from the distributing station for six miles to a point on the Niagara River near the town of Queenstown, where they cross the gorge, and connect with the lines of the Niagara, Lockport, and Ontario Power Company delivering power for use in the United States. These lines consist of aluminium conductors $1\frac{1}{8}$ inches in diameter, carried on steel towers 55 feet high to the top wire, with an average span of 500 feet. The insulators for this line are of porcelain, and weigh 35 lb. each.

The first of the transmission lines was put into operation on July 7, 1906, and the plans realised at present, and contemplated for the immediate future, in the plant of the Niagara, Lockport, and Ontario Power Co., involve a maximum transmission distance of 160 miles. This distance puts the plant amongst the longest transmissions of the world.

Size of Cables.—There are only three sizes of cables used on the main transmission lines, designated by the company as 3/3, 2/3, and 1/3 respectively. The 3/3 cable is aluminium cable, consisting of nineteen strands, and having a total area of 642,800 cir mils, being equivalent to 400,000 cir mils copper. The areas of cross-section of the other cables are respectively two-thirds and one-third that of the large one.

It is impossible to enumerate the manifold purposes for which the power is used, but some of the more important are the following:—

Light.—The power generated at this station and sent out over the above-described transmission lines furnishes part or all of the public and private lighting in Niagara Falls, Welland, Stamford, and St. Catherines, Ontario; and Lockport, Depew, West Seneca, Hamburg, Batavia, Rochester, Canandaigua, Auburn, Baldwinsville, Phœnix, Fulton, and Syracuse, New York.

Heat.—The same power operates electric furnaces for the reduction of iron, copper, and other ores, and the manufacture of cement, calcium carbide, and lime nitrates in Port Colborne, Welland, Niagara Falls, and Thorold, Ontario, and Lewiston, Lockport, and Caledonia, New York.

Power.—The same power operates wholly or in part the trolley systems in Syracuse, Rochester, Canandaigua, Geneva, West Seneca, and Hamburg; and the interurban lines Syracuse, Lake Shore and Northern Syracuse and South Bay, Rochester and Geneva, Rochester and Mount Morris (Erie Railroad), Buffalo, Lockport and Rochester, Buffalo and Hamburg, and Buffalo and Dunkirk (partly constructed). It operates the steel works of the Ontario Iron and Steel Company at Welland, Lackawanna Steel Company (7000 employees), Shenandoah Steel Wire Company, plate-rolling mills of Seneca Iron and Steel Company, and pumping works of Depew and Lake Erie Water Company at West Seneca; repair shops of the New York Central and Hudson River Railway Company, and Delaware, Lackawanna and Western Railroad Company, and the works of the Gold Coupler Company at Depew, stone-crushing establishment of the Kelley Island Lime and Transport Company at Akron; works of the United States Gypsum Company at Oakfield, and various smaller industries located on main transmission lines.

The utilisation of a portion of the vast energy of Niagara without in any way detracting from the splendour or beauty of the Falls is destined to create in the Ontario peninsula and in western New York a vast manufacturing district.

SCIENTIFIC WORK OF THE SMITHSONIAN INSTITUTION.

THE report of Dr. Charles D. Walcott, secretary of the Smithsonian Institution, for the year ending June 30, 1909, has just been issued. All the numerous departments of the institution's activity receive attention, but it is possible here to deal only with the more direct scientific work accomplished during the year under review. Subjoined is a summary of the parts of the report dealing with matters of scientific interest.

Smithsonian African Expedition.

Through the generosity of friends of the institution, there was provided during the year a special fund to pay for the outfitting and to meet the expenses of the naturalists on a hunting and collecting expedition to Africa under the direction of Colonel Theodore Roosevelt. No part of the fund was derived from any Government appropriation or from the income of the institution. The special interest of the institution in the expedition is the collection of biological material for the United States National Museum.

The party sailed on March 23, 1909, from New York, whence steamer was taken to Mombasa, British East Africa. The expedition arrived in Africa on April 21. A letter, dated at Nairobi, May 31, announced the shipment of twenty barrels of large mammal skins in brine, comprising Colonel Roosevelt's first month's collection. While no new species, so far as is known, is included in this first shipment, the collection will supplement materially the specimens already in the National Museum. Together with this shipment are expected a large number of specimens of small mammals, and also of birds. Through the Smithsonian African expedition the National Zoological Park has been presented with an exceptional collection of live African animals.

Cambrian Geology and Palaeontology.

Dr. Walcott's studies of the older sedimentary rocks of the North American continent, which he has been carrying on as opportunity offered for more than twenty years, were continued in Montana and the Canadian Rockies during the field season of 1908. The scientific results of the 950-mile trip through the forests and on mountain trails will aid materially in the solution of several problems connected with the stratigraphy and structure of the main ranges of the eastern Rocky Mountains and of the geological position and age of many thousands of feet of the sandstones, shales, and limestones forming the mountains in northern Montana, British Columbia, and Alberta. On the return an examination was made of the geological formations in the vicinity of Helena, Mont., and of the Wasatch Range, south-east of Salt Lake City, Utah. Three additional papers giving a summary of the results of these studies in Cambrian geology and palæontology were published during the year.

Researches on Atmospheric Air.

A Hodgkins grant was approved in October, 1908, for the erection of a small stone shelter on the summit of Mount Whitney, California, for the use of investigators during the prosecution of researches on atmospheric air, or on subjects closely related thereto. The pioneer trip to the summit of Mount Whitney in the summer of 1881 by the late secretary, Dr. Langley, at that time director of the Allegheny Observatory, will be recalled in this connection, as well as his conviction that in no country is there a finer site for meteorological and atmospheric observations than Mount Whitney and its neighbouring peaks.

Mr. C. G. Abbot, who succeeded Secretary Langley as director of the astrophysical observatory of the Smithsonian Institution, and to whose immediate suggestion and earnest personal efforts the preparation for and the establishment of this important post on Mount Whitney are largely due, began his observations there in the summer of 1909, and obtained important data in the determination of the solar constant. The cooperation of Prof. W. W. Campbell, the

director of Lick Observatory, University of California, at Mount Hamilton, has been most helpful during the erection of the shelter. The class of researches to be prosecuted at this exceptionally favourable station are not only of great scientific interest, but are expected also to prove of value in determining questions having a direct, practical influence on the preservation and progress of human life on our globe.

International Standard Pyrheliometers.

A limited grant from the Hodgkins fund was approved in February, 1909, for the construction of several silver disc pyrheliometers. These instruments are to be placed in charge of scientific investigators in widely separated localities for the purpose of establishing an international scale for the comparison of observations on solar radiation. The varying results published by observers have made the need of international cooperation in this connection apparent, and the matter has received considerable attention at conferences of the Solar Union. These simple and comparatively inexpensive instruments are to be constructed after a design by Mr. Abbot. Similar pyrheliometers have been employed in the researches of the Astrophysical Observatory for several years, and have proved entirely satisfactory.

Langley Medal and Memorial Tablet.

As a tribute to the memory of the late secretary, Dr. S. P. Langley, and his contributions to the science of aërodromics, the regents of the institution adopted the following resolution on December 15, 1908:—"That the board of regents of the Smithsonian Institution establish a medal to be known as the Langley medal, to be awarded for specially meritorious investigations in connection with the science of aërodromics and its application to aviation." Following the establishment of this medal, a committee of award, composed of gentlemen of recognised attainments in the science of aërodromics, was appointed. The committee recommended that the first medal be bestowed on Messrs. Wilbur and Orville Wright, and the medal was awarded on February 10, 1909. Designs for the Langley memorial tablet are now being prepared by a well-known architect of Washington.

National Museum.

More than 250,000 specimens were added to the museum collections during the year, about 200,000 of them pertaining to biology and the remainder to geology and anthropology. One of the most important additions to the division of ethnology was a contribution from Dr. W. L. Abbott, consisting of about 500 objects from south-western Borneo. To the technological collections were added more than 200 objects transferred from the United States Patent Office. The department of biology received a noteworthy gift of about 1200 European mammals and sixty-one reptiles from Mr. Oldfield Thomas, of the British Museum, and Mr. Gerrit S. Miller, of the National Museum. This has so greatly increased the importance of the National Museum collection of the mammals of Europe that it now ranks as one of the largest and most valuable in the world. Mention must also be made of a contribution of about a thousand mammals and birds of Borneo, received from Dr. W. L. Abbott.

In connection with the work of excavation and repair of the Casa Grande ruins in Arizona, under the direction of the Smithsonian Institution, there were collected and placed in the National Museum about 650 stone axes and hammers, rubbing and grinding stones, earthenware bowls and vases, pieces of basketry and textile fabrics, shell ornaments, and wooden implements. From similar excavations in the Mesa Verde National Park, Colorado, there were received about 500 objects of like character. The department of geology received a large series of Cambrian fossils from the Rocky Mountains, collected during Dr. Walcott's field studies in that region. There were also added to the collections many objects pertaining to mineralogy and palæobotany. Eighty-two regular sets of geological specimens to the number of 7739 were distributed during the year for educational purposes, besides 1300 specimens of geology, marine invertebrates, and fishes arranged in special sets.

Two field parties in which the institution and museum are greatly interested left America during the year for important collecting regions, from both of which valuable results may be expected. The first will explore Java and some of the adjacent islands; the second expedition is that under the direction of Colonel Theodore Roosevelt into British East Africa and more inland districts.

Bureau of American Ethnology.

The bureau has collected data relating to sixty families or linguistic stocks and upward of 300 tribes. It does not expect to study all the tribes in detail, but rather to investigate a sufficient number as types which may stand for all. It has seemed wise at this stage of the researches to prepare a summary of our knowledge of the tribes, and this has taken the form of a "Handbook of the Indians," of which one large volume is published and the second nearly through the press.

The people of the United States have two great obligations which the bureau is trying to fulfil:—(1) that of acquiring a thorough knowledge of the Indian tribes in the interests of humanity; (2) that of preserving to the world an adequate record of the American race which is so rapidly disappearing.

Recently much interest has been manifested in the antiquities of the country, more especially in the great pueblo ruins and cliff dwellings of the arid region, and the fifty-ninth Congress enacted a law for the preservation of these antiquities. A first step in making this law effective is their exploration. A second is the excavation and repair of the more important ruins to ensure their preservation and to make them available to the public and for study. Dr. J. Walter Fewkes, of the bureau, has continued the work of excavation and repair of the ancient ruins in the Mesa Verde National Park. During the year the repair of Spruce Tree House was completed, and at the end of June excellent progress had been made in uncovering and repairing the crumbling walls of Cliff Palace, the greatest of the ancient ruins of its kind in the United States.

There is need also for ethnological work in the Hawaiian Islands and Samoa, for the following reasons. It is regarded as most important that the Government should have definite and detailed information regarding the native inhabitants of these islands, which are under its control and for whose welfare it is responsible. It is not less a duty of the nation to preserve some record of this peculiar race for the purposes of history and science, as neglect will become a source of deep regret. An experienced ethnologist should make investigations regarding the history, social institutions, religion, and general culture of the people, and a physical anthropologist should study their physical and mental characteristics.

National Zoological Park.

The National Zoological Park during the year added 576 new animals to its collections, which offsets a loss of 562 by exchange, death, and return of animals, and brings the number of individuals on hand, June 30, 1909, up to 1416. The entire support of the park was derived from an appropriation of 19,000*l.* for general purposes, including the purchase, transportation, care, and maintenance of animals; the care and improvement of grounds; the construction and repair of all buildings, enclosures, roads, walks, and bridges. Of this amount, the increased price of necessary provisions and labour brought the cost of maintenance alone to about 17,000*l.* It was therefore possible to do little toward permanent construction or improvement.

Astrophysical Observatory.

The work of the Astrophysical Observatory during the year consisted:—(1) Of bolometric observations carried on at Washington on the brightness of different parts of the sun's image; also some experimental work on the transparency of the air for long-wave rays, such as the earth radiates. A computation of the results of these experiments is now far enough advanced to show their satisfactory quality. Precise knowledge of the selective absorption of our atmosphere for earth rays is still lacking, and contradictory views are still being expressed about this

important subject; hence it is hoped that these experiments will be useful in the study of the dependence of the earth's temperature on radiation.

(2) Spectrobolometric measurements of the solar constant of radiation have been continued at the Mount Wilson Observatory in California. As in former years, evidences of a fluctuation of solar radiation were found in the results of the measurements thus far obtained. A new and improved standard pyrheliometer was found to be more satisfactory than the one used in 1906, and great confidence is felt in the results obtained with it. Efforts have also been made to carry the bolometric measurements much farther in the ultra-violet through the use of a large quartz prism, a large ultra-violet glass prism, and two magnalium mirrors.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The special board for biology and geology has appointed Mr. Leonard Doncaster, of King's College, to be superintendent of the Museum of Zoology, and the Vice-Chancellor has approved of the appointment.

GLASGOW.—Principal Sir Donald MacAlister, K.C.B., has been appointed to represent the Senatus of the University at the centenary festival of the University of Berlin in October next.

A scheme for the formation of a clinical branch of the medical school of the University, to be situate at the Royal Infirmary, was approved by a Parliamentary Commission, after a two days' hearing, on April 1. The provisional orders for the purpose contemplate the establishment of four professorial chairs at this infirmary, in addition to those held at the Western Infirmary, namely, those of medicine, surgery, obstetrics, and pathology. The necessary funds, amounting to about 2000*l.* a year, are provided for from existing endowments and by grants from St. Mungo's College, the Muirhead trustees, and other benefactors. All the instruction thus provided will be open to women students of the University as well as to men.

THE late Colonel G. E. Church, who died on January 4, bequeathed 1000*l.* to the Royal Geographical Society towards a fund for the enlargement of its premises or towards a new building for its use. He left to Harvard University his collection relating to North and South America, consisting of books of travels, voyages, explorations, boundary-line questions, geography, ethnology, and history, as well as all writings by Latin and American authors, to be known as the "George Earl Church Collection." Should the authorities of the University not accept this gift within four months of his death, then the collection is to be offered to the Brown University, Rhode Island, or the Stanford University, in California.

IN Class iv. (Education, Science, and Art) of the Civil Service Estimates for the year ending March 31, 1911, the estimate amounts to 18,651,483*l.*, a net increase of 697,718*l.* on the amount voted in 1909. The estimate for the Board of Education shows a net increase of 417,663*l.*, of which 348,775*l.* arises under the subhead of grants in respect of public elementary schools, &c. A sum of 200,000*l.* is again provided for special grants to certain necessitous local education authorities. The estimate for scientific investigation, &c., includes a grant of 7500*l.* in aid of the expenses of the aëronautical section of the National Physical Laboratory, and a grant of 20,000*l.* in aid of the expenses of the British Antarctic Expedition of 1910.

THE following courses of free advanced lectures have been arranged by the University of London:—a course of five lectures on "Fertilisation and Related Phenomena," to be given by Prof. J. B. Farmer, F.R.S., at the Royal College of Science, on Wednesdays at 5 p.m., beginning on April 27; a course of five lectures on "The Anatomy of Plants in Relation to External Conditions," to be given by Mr. L. A. Boodle at University College on May 26, May 30, June 2, June 6, and June 9, at 5 p.m. A course of three lectures on "The Geology and Geography of Charnwood Forest" will be given by Prof. W. W. Watts, F.R.S., at the Imperial College of Science and Technology, on Mondays at 5 p.m., beginning on April 25. The lectures are addressed to advanced students of the University anc to others interested in the subjects. Admission is free, without ticket.

THE difficulty of reaching the cultivator of the soil fo any educational purpose has not as yet been overcome ir any country, and certainly not here. Some interest, therefore, attaches to a scheme that has been at work in the West Indies for about eighteen months, and has provec so effective that it is to be adopted permanently. Courses for home reading are drawn up, divided into three parts at the end of each of which are held examinations knowr respectively as the preliminary, the intermediate, and the final. The preliminary examination requires a general allround education, and is dispensed with in the case o students who possess certain qualifying certificates. Th intermediate examination requires such knowledge of th general principles of agriculture, and of planting work ir particular, as might be expected from an intelligent overseer of a few years' experience, while the final examination reaches the standard necessary for a man capable o managing an estate. A leaflet is issued by the Wes Indian Agricultural Department containing a syllabus o the subjects necessary for each part, with hints as to wha books should be read. In addition, the *Agricultural News* the fortnightly paper issued by the Department, devote nearly a page in each issue to notes bearing on the curren work of the estate, thus giving the necessary practica illustrations of the general principles set out in the text books. A few questions are also set which students ar advised to attempt. The Department, however, does no set up to act as a correspondence college and correct th answers to the questions. It is left to the student t find someone who will discuss his work with him and hel him over those hard places where a man, reading on hi own account without any assistance, inevitably get stranded sooner or later. At first the officers of the Depart ment gave a good deal of help by organising students meetings where difficulties could be discussed; voluntar workers also came forward. The examinations are con ducted by the staff of the Department, acting in conjunc tion with some of the planters. The intermediate and th final are essentially technical in their nature; the candidat is expected to be a better man at field or plantation worl as a result of his reading, and he must demonstrate hi superiority to the satisfaction of the planters on th examining board. In this way the interest and sympath both of masters and of men can be enlisted, and both ar brought to realise that the certificates awarded indicat increased efficiency on the part of the holder. Interest i the scheme is said to be spreading among the cultivator while the organisers have found certain modifications th will still further increase its utility. It will be carefull watched by those in this country who are engaged i elementary agricultural education.

THE National Union of Teachers held its conference th year at Plymouth during Easter week. Naturally, most their discussion was confined to various aspects elementary education, but other subjects of nation importance were also considered. Mr. Marshall Jackma the president, was chiefly concerned with a demand f more money from the Treasury for elementary educatio to relieve the financial straits in which many local educ tion authorities find themselves. Mr. Jackman contend that we build Dreadnoughts regardless of cost, not becau we want them, but because we feel the necessity of kee ing pace with our neighbours. If we could have a simil cry in education to the Two Power standard cry for t Navy we should be able to do much for educational pr gress. He set out a national educational standard whi he thought was worthy of this great Empire. Is it t much to demand that the educational opportunities f British boys and girls shall be no less than those for t children of any other nation? His new standard was th all forms of education should be as free to the Briti child as to the American child, the elementary schools Britain should be manned by teachers no less efficie than those in the schools of Sweden, the classes of t schools in Britain should be no larger than those of De

mark, and the health of the children in this country should not be less cared for than that of the children in German schools. The care of adolescents came in for careful debate. Sir Henry Hibbert, chairman of the Lancashire County Education Committee, said the duty of providing further discipline and training for all children during the years which follow the day-school period is receiving attention in many countries, all of which seem to be moving towards three conclusions:—(1) that increased effort should be made by the State to compel local authorities to organise, according to the needs of different localities and of different trades, courses of instruction useful to any child, and so planned as to train them for healthy living and for the duties of citizenship; (2) that there should be a further delimitation of the hours of juvenile labour; and (3) that all employers, Government as well as private, should be compelled by law to enable any persons of less than seventeen or eighteen years of age employed by them to attend courses of instruction, general or technical, for a specified number of hours per week at times during which the pupils would not be too tired to profit by the instruction. Dealing with the same subject, Miss Adler, of the London County Council, explained that the aim of the trade schools of the London County Council is not entirely to supersede apprenticeship, but to reduce the period of indenture, and to enable the lad to enter the workshop already equipped to take an intelligent interest in workshop processes, to handle tools effectively, and to be in a better position to learn by observation than the lad who enters the workshop direct from school. The development of handicraft side by side with the general intelligence is the primary aim of the trade school, and when this is possible on practical lines postponement of entry into the workshop is a distinct advantage, more especially when the trade side of the work is to some extent supervised by members engaged in the industry taught in the school. It was pointed out during the conference that the cost of compulsory attendance between fourteen and seventeen would be some 2,625,000*l.*, and if the age were increased to eighteen 3,500,000*l.*

SOCIETIES AND ACADEMIES.

LONDON.

Royal Microscopical Society, March 16.—Prof. J. A Thomson, president, in the chair.—Miss L. S. M. **Summers**: Antipatharians from the Indian Ocean. Fourteen species were dealt with, including three which are new, viz. *Cirripathes indica, Antipathes salicoides, Pteropathes simpsoni.* In several cases the presence of well-preserved polyps made it possible to remove some of the doubts which Brook expressed in regard to various species. The paper referred also to certain peculiarities in the polyps and spines. The collections were made at Ibo, in Portuguese East Africa, and in the Mergui Archipelago.—E. M. **Nelson**: The visibility of the tertiaries of *Coscinodiscus asteromphalus* in a balsam mount. The author directed attention to the continued improvement in microscope objectives, and particularly to a new ⅛-inch objective by Zeiss. Twelve years ago he received a slide of Nottingham deposit mounted in sulphide of arsenic, and he then saw, for the first time, the tertiaries in *Coscinodiscus asteromphalus.* He had had a balsam mounted selected slide of this diatom since 1876, and had tested hundreds of objectives upon it, but these tertiaries had never been visible. Recently he received from Messrs. Zeiss a long tube ⅛-inch apochromatic object-glass of N.A. 1·4, and it was tested on this balsam-mounted slide. The tertiaries which had for so many years eluded the grip of all kinds of lenses were conspicuous. This apochromatic ⅛-inch was more sensitive to tube length, stood a larger axial cone, bore a deeper eye-piece, and had sharper definition than any microscope lens he had previously seen.—A. A. C. Eliot **Merlin**: The measurement of the diameter of the flagella of the cholera bacillus prepared by Löffler's method. Slides of bacteria are prepared by Löffler's method to render the flagella more easily demonstrable, as the organism and its appendages are greatly distended by the process, thus rendering them comparatively coarse objects. Little has been attempted as regards the measurement of these appendages since Dr. Dallinger read his paper on the measurement of the diameter of the flagella of *Bacterium termo* in 1878. The author of the paper obtained his results by what are termed extinction measurements, the resulting measurements being for the finest flagella 1/64725-inch and for the coarser 1/62226-inch. He checked these results by measuring, by means of a filar micrometer, the flagellum of a selected specimen, the measurement by this method giving a diameter of 1/66756-inch as against 1/64725-inch of a flagellum of approximately similar fineness measured by the extinction method.

Geological Society, March 23.—Prof. W. W. Watts, F.R.S., president, in the chair.—L. **Moysey**: Palæoxyris and other allied fossils from the Derbyshire and Nottinghamshire Coalfield. After reviewing the bibliography of Palæoxyris, the author records the finding of twenty-two specimens from Shipley Clay-pit (Derbyshire) and above 130 from Digby Clay-pit (Nottinghamshire), also several isolated examples from other localities in the district. He describes *Palaeoxyris helicteroides* (Morris), noting especially the presence of a "beak," which had not hitherto been adequately described. He then describes *Palaeoxyris prendeli* (Lesquereux) from Shipley Clay-pit, again noticing the formation of the "beak." The discovery of *Palaeoxyris johnsoni* (Kidston) from Digby is noted, and it is proposed that this fossil be removed into the genus Vetacapsula. The author also describes a specimen of *Vetacapsula cooperi* (Mackie and Crocker) from Newthorpe Clay-pit (Nottinghamshire).

CAMBRIDGE.

Philosophical Society, March 14.—Prof. Bateson, president, in the chair.—Sir J. J. **Thomson**: The cause of the phosphorescence of the glass in vacuum tubes when the pressure is not very low.—J. A. **Crowther**: Transmission of β rays.—J. L. **Glasson**: Secondary X-rays from metallic salts. These experiments show that the absorption coefficient of the secondary homogeneous X-rays from the metals of the chromium-silver group is unaffected by the combination of the metal with certain acid radicles. The only effect of the combination is the superposition of a small quantity of hard scattered radiation on the homogeneous radiation of the metal. Moreover, the valency of the element has no influence on the secondary homogeneous radiation from it. The absorption coefficient of the characteristic radiation from manganese is deduced from the absorption curve of manganese sulphate.—S. G. **Lusby**: Some experiments on ionisation in dried air. All the known properties of ions have been found to vary with the amount of moisture present in the gas experimented on, but in all cases the negative ion is the more susceptible. Hence it was thought that if the gas were dried, it should acquire a positive charge. The experiment was therefore tried, liquid air being used as the drying agent. On testing a stream of air which had been ionised and then dried, no indication of electric charge was detected. By using another method, it was found that both the positive and the negative ionisation are increased greatly by this drying action, but in an equal ratio, which in some cases amounted to ten. This was found to be due to decreased re-combination. The effect could be eliminated by previously filtering the air.

DUBLIN.

Royal Dublin Society, March 22.—Mr. R. Ll. Praeger in the chair.—Prof. T. **Johnson** and Miss R. **Hensman**: Agricultural seeds and their weed impurities; a source of Ireland's alien flora. The first-named author stated that as under the Weeds and Seeds Act for Ireland he had ceased to be responsible for the seed-testing station of which he had been director during the ten years of its existence (1900–9), the paper he communicated gave a summary of the purity and germination percentage of the 11,000 samples of seeds already tested, and of the weed-seeds found in these samples. Utilising the results of Dr. Stebler's investigations, he showed how many of the weed-seeds serve as source-indicators of the agricultural seeds sold. The paper contains also a list of casuals already recorded in the Irish flora, so far as these are traceable to introduction in seed. A list of 120 weed-seeds is given, 75 per cent. of which are the seeds of non-indigenous weeds.

PARIS.

Academy of Sciences, March 29.—M. H. Poincaré in the chair.—Paul **Sabatier** and A. **Mailhe**: The mechanism of the dehydration of alcohols by the catalytic action of various metallic oxides. The action of sulphuric acid and of metallic oxides upon alcohols at various temperatures is compared, and the possibility of the formation of a compound of the oxide and alcohol analogous to ethylsulphuric acid considered.—M. **Carpentier**: A description of a new electrical measuring instrument, the logometer.—Charles **Nordmann**: Remarks on a preceding communication.—G. **Denigès**: The detection of methyl alcohol in general, and especially in the presence of ethyl alcohol. The method, full details of which are given, is based on oxidation by potassium permanganate in dilute sulphuric acid solution. Formaldehyde is produced, and is detected by fuchsine decolorised by sulphurous acid.—P. **Yvon**: Aniline arsenyl tartrate. Details of the preparation and physical properties.—A. **Guilliermond**: New observations on the cytology of yeasts. The results of the experiments given are entirely opposed to the views put forward by Wager and Peniston.—M. **Dugast**: The presence of boron in Algerian wines. All the Algerian wines examined, of known origin and purity, were found to contain boron.—E. **Chuard**: A new method of treating for mildew by oxychloride of copper. The substitution of the oxychloride of copper for the mixtures of copper sulphate and lime reduces the amount of copper used to one-half.—Maurice **Gignoux**: The classification of the Pliocene and the Quaternary in southern Italy.—Jules **Welsch**: The formation of the Poitevin Marais and the separation of the "islands" of Ré and Oleron.

DIARY OF SOCIETIES.

THURSDAY, APRIL 7.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

LINNEAN SOCIETY, at 8.—Elm-seedlings showing Mendelian Results: A. Henry.—On the Foraminifera and Ostracoda from Soundings, chiefly deep-water, collected round Funafuti by H.M.S. *Penguin*: F. Chapman.

RÖNTGEN SOCIETY, at 8.15.—Some methods of using the Alternating Current Mains for Röntgen Ray Work: Dr. G. B. Batten.—Treatment of X-Ray Dermatitis by Radium: Mackenzie Davidson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Progress of Electric Braking on the Glasgow Corporation Tramways: A. Gerrard.

FRIDAY, APRIL 8.

ROYAL INSTITUTION, at 9.—Lowell Observatory: Photographs of the Planets: Prof. Percival Lowell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Reconstruction and Extension of Egremont Ferry Pier: G. H. Hodgson and H. M. Gell.

PHYSICAL SOCIETY, at 8.—An Experimental Demonstration of the Loading of Artificial Telephone Cables: B. S. Cohen.—Further Tests of Brittle Materials: W. A. Scoble.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Note to Paper on Star Colours and Spectral Types: W. S. Franks.—*Probable Papers*: Investigations relating to the Spectra of Comets: A. Fowler.—Places of Halley's Comet, 1909–1910, deduced from Photographs taken at the Radcliffe Observatory, Oxford: A. A. Rambaut.—Proper Motions: Astronomer Royal for Scotland.

SATURDAY, APRIL 9.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer.

MONDAY, APRIL 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Across Africa from the Niger to the Nile: Dr. Karl Kumm.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Brick-making: Dr. A. B. Searle.

TUESDAY, APRIL 12.

ROYAL INSTITUTION, at 3.—The Modern Development of the Problem of Alcoholic Fermentation: Dr. A. Harden, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Charcoal Burning in Epping Forest: S. Hazzledine Warren.—Additional Notes on the British Camp at Wallington: H. C. Collyer and N. F. Roberts.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The New Clyde Bridge of the Caledonian Railway at Glasgow: D. A. Matheson.—The Queen Alexandra Bridge over the River Wear, Sunderland: F. C. Buscarlet and A. Hunter.

WEDNESDAY, APRIL 13.

ROYAL SOCIETY OF ARTS, at 8.—The Port of Dover: A. T. Walmisley.

GEOLOGICAL SOCIETY, at 8.—The Volcano of Matavanu in Savaii: Dr. Tempest Anderson.—Notes on the Geology of the District around Llansawel (Carmarthenshire): Miss Helen Drew and Miss Ida L. Slater.

THURSDAY, APRIL 14.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Viscous Flow in Metals and Allied Phenomena: E. N. da C. Andrade.—The Refraction and Dispersion of Argon and Redeterminations of the Dispersion of Helium, Neon, Krypton and Xenon: C. and M. Cuthbertson.—The Action of the Radiation from Radium Bromide upon the Skin of the Ear of the Rabbit: J. O. W. Barratt.—And others.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

FRIDAY, APRIL 15.

ROYAL INSTITUTION, at 9.—The Chemical Significance of Crystal Structure: Prof. W. J. Pope, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.

SATURDAY, APRIL 16.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer

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THURSDAY, APRIL 14, 1910.

THE CLAIMS OF LONG DESCENT.

Vorträge über botanische Stammesgeschicte, gehalten an der Reichsuniversität zu Leiden. Ein Lehrbuch der Pflanzensystematik. Zweiter Band, Cormophyta Zoidogamia. By Dr. J. P. Lotsy. Pp. 902. (Jena: Gustav Fischer, 1909.) Price 24 marks.

THE expectations aroused by the first volume of this work, which dealt with the Thallophyta, will not be disappointed by that now issued, in which are included the liverworts, mosses, ferns and fern-allies, and also the seed-producing plants that possess ciliated male cells. In its wide compass are thus at the one extreme types of a very low grade of complexity, while at the other stands Ginkgo, long regarded as a true conifer. The endeavour to trace the ancestry of the types in this range of forms raises many of the most interesting and suggestive problems in systematic botany, towards the answers to some of which much progress has been made in recent years.

The contributions to their solution have been made in a literature so scattered, and in so many languages, that much of what has been published is difficult of access, and is apt to remain unknown to students; hence the gain is great when it is collected, analysed, and presented in clear and systematic form, especially when accompanied, as it is here, with an excellent bibliography and ample references to the original sources of information. Such a work as this must necessarily be very largely a compilation if it gives an adequate statement of the present state of knowledge and of the explanations put forward upon many disputed questions; but the author has added to its value by discussing these questions and stating the reasons for and against the solutions advanced.

While indication of relationships and of lines of descent is, as the title of the book implies, a prominent feature throughout, its scope is much wider than this, so that it is an admirable handbook to the study of the structure and life-cycles of the groups discussed in it.

In a brief review it is not possible to note more than a few of the many questions that arise in the consideration of the plants included in this volume. These plants agree in showing a cycle in which there is a marked contrast between the gametophyte and the sporophyte, or the x- and the 2x-generations, as Dr. Lotsy prefers to express them; and they also have the archegonium recognisable, though obscured among the higher forms. The two great divisions of Haploidales and Diploidales, characterised by the dominance of the x- and the 2x-generations respectively, express the recognition that recent discoveries have shown clearly the intimate relationships between the ferns and the seed-plants. After discussing the hypotheses with regard to the origin of the Haploidales and Diploidales, the author supports the view that they are derived by independent lines from Algæ of the group Isokonta. As to the origin of the antithetic generations in the cycle, he holds that the evidence does not warrant a dogmatic conclusion; but in discussing the homologies of leaf and stem in the Diploidales he inclines to Potonie's hypothesis that both represent specialised parts of a thallus, and may be homologous with one another. Among the Haploidales the evidence points more directly to the same conclusion.

The structure and life-histories of a typical moss and of a typical fern are set in contrast; and then follows a similar account of a very simple (? primitive) type of each, to ascertain in how far the supposed algal ancestry can be traced. Then follows a survey of the genera under each division, including every genus that shows features of importance or interest, morphological or biological; and not a few questions of wider than mere systematic value are discussed clearly and helpfully, as they arise in connection with certain forms, *e.g.* under Hepaticæ are discussed the suggestion that Anthoceros may represent a stage in the development of the sporophyte in Diploidales, the origin of the foliose habit, adaptations for economising water in various types, the influence of light on dorsiventral structure, &c. The wide range of structure and of adaptability among Hepaticæ is emphasised as in marked contrast to the relative fixity of type among the true mosses; but among the latter many features of biological import are duly noticed, such as the methods of vegetative multiplication, and their relation in frequency to the greater or less difficulty in securing the union of the male with the female cells.

The classification of the mosses into Acrocarpi and Pleurocarpi is held to be too artificial, as is also the importance attached to the rupture of the capsule in the normal manner by a lid, those forms in which the lid is not broken away being regarded as not forming a related group, but rather as aberrant from various families. Examples are quoted of very long-continued vitality in the spores of certain mosses, up to fifty years in a species of Œdipodium. The enlargement and flattening of the apophysis in Splachnum, and the growth of root-hairs from the seta in Eriopus, may be regarded as efforts on the part of the sporophyte to provide nourishment for itself; but they only emphasise the dependence of the sporophyte upon the gametophyte among the mosses.

In sharp contrast to them, in this respect, stand the vascular plants or Diploidales, although for a brief period, during early germination, the sporophyte fern is as dependent on the gametophyte for nutrition as is the moss-capsule. The dominance of the sporophyte becomes always more evident as the adaptation to life as land-plants becomes more complete, and as the dependence on surface-water to allow of fertilisation of the ovum is done away with, until in the Angiosperms it becomes difficult to trace the gametophytes with certainty, and the sporophytes appear to be themselves sexual, as was long the interpretation of the structure of flowers.

Dr. Lotsy gives a very helpful explanation of the discoveries that in recent years have thrown so much light on the affinities of the great divisions of the Diploidales, and have broken down the distinction between Phanerogamia and Cryptogamia, discoveries in which the English-speaking races have taken so great

a part. It is now evident that the tendency to retain the megaspore within the sporangium, and to continue to nourish the gametophyte and also its offspring, the sporophyte, through the sporangium until the young sporophyte is provided with sufficient food in reserve to enable it to begin life on its own account with a fair prospect of success, resulting in the production of the seed, has originated in widely different types, and therefore on independent lines. Thus the true significance of the seed, as an adaptation to secure the fuller possession of the earth's surface, and to escape the dangers of dependence on water for the fertilisation of the egg-cell, has become realised. A new era in botany opened with the recognition of the common ancestry of ferns and cycads, based on similarities in their structure, by the discovery that supposed ferns of the Carboniferous strata produced true seeds resembling those of cycads in important respects, and on the not less startling discovery, which we owe to Japan, of the ciliated male cells in the pollen of Ginkgo and of the cycads. Of these and other great advances in recent years, such as in the knowledge of the Cycadeoidea, Dr. Lotsy gives a very clear account, which should be most helpful to students.

The vascular plants possessed of ciliated sperms, the Zoidogamia, he divides into two great groups characterised by the sperm-cells, which possess two cilia in the Lycopodineæ and their allies, and many cilia in the Filicineæ and seed-formers. He points out that this agrees with the groups based by Lignier on the structure of the leaves. Heterospory has been attained independently in several lines of descent in both these groups, and is thus no certain proof of close relationship among plants in which it occurs. His arrangement is in several respects a good deal different from that in use in English text-books, both in the relations of the larger divisions and in such minor details as breaking up Hydropterideæ and placing Marsiliaceæ beside Schizæaceæ, and Salviniaceæ beside Hymenophyllaceæ, among the leptosporangiate filices.

On similar grounds Selaginella is brought back to Lycopodiaceæ, while Isoetes is placed between the Equisetaceæ and Filices, because of its polyciliate male cells and of the development of its spores and embryo. The present state of knowledge with regard to the structure and life-histories of the Lycopodiaceæ and their allies is in striking contrast to that of not many years back; and of this advance the author gives a good account. The relations of the alliance to other groups can now be estimated in a truer light than was formerly possible. Though certain types within it had advanced far on the way to the formation of seeds, there is no clear evidence pointing to the descent from them of any existing seed-plants.

The lectures treating of the ferns and their allies are of very special interest, in view of the ever-increasing evidence connecting them with the descent of the seed-plants. While the progress during the past decade has been very great, and has revolutionised former beliefs, it has shown also that the production of seeds had already been attained at a period so far back in geological history as to make it very improbable that direct proof of the lines of evolution will be obtained. But while great problems will probably remain unsolved in detail, the general trend of progress has become evident, and there is reason to anticipate that the rate of advance will not slacken; though it seems scarcely likely that there can be many future discoveries so startling as those already alluded to.

The grouping of the leptosporangiate ferns takes full account of Prof. Bower's researches on the sporangia. The eu-sporangiate types, like the leptosporangiate, are derived from the Primo-filices, by separate lines of descent. The Pteridospermeæ are probably more nearly related to Marattiaceæ than to any other existing ferns, but over a very wide gap. The concluding lectures of this volume treat of the Cordaitales, Bennettitales, Cycadales living and extinct, and Ginkgoaceæ. They present subjects of extreme interest, and of the utmost importance in tracing the development of the higher plants.

Those who read this volume will feel that while it demands close attention, and while some of the lectures are of value for reference on subordinate groups rather than for questions of wider interest, the work well repays the attention necessary, and that the aim, kept steadily in view, has been successfully attained, to supply an unbiassed and worthy representation of what is at present known with regard to the groups of plants discussed. The information brought together within its compass has been gathered from a vast field; and the sources from which it has been taken are scrupulously indicated, as regards both text and the excellent and copious illustrations, which do much to aid the exposition, clear though that is. We cannot but feel that it is more useful in its present form, available to be read and re-read, than it could be as a course of lectures. It must prove a great boon to students desirous to obtain an adequate guide to the researches of recent years, in a form that can permit of use as a work of constant reference, from which they may gain wider views of the science of botany.

The third volume, on siphonogamous seed-plants, will be most welcome, though it can scarcely deal with subjects of such interest, or so full of the charm of advancing knowledge. The standard of the two volumes already published is a guarantee for the expectation that it will be a most valuable addition to every botanical library.

UTILISATION OF PEAT.

Commercial Peat: its Uses and Possibilities. By F. T. Gissing. Pp. x+191. (London: Charles Griffin and Co., Ltd., 1909.) Price 6*s.* net.

IN this volume on peat, which is a companion one to that published in 1907 by Messrs. Björling and Gissing, the author's aim is the description, from a commercial point of view, of the various processes proposed for the utilisation of peat.

In pursuance of this object Mr. Gissing describes fully the preparation from peat of alcohol, moss litter, and paper, the cutting and drying of peat, and the manufacture of press turf and of machine turf, but the greater part of the book deals with the products got by the destructive distillation of peat.

The book is clearly written, contains many interesting illustrations, and, when taken in conjunction with Messrs. Björling and Gissing's work, forms a very complete descriptive account of the peat industries. Occasionally, however, the author, carried away by his enthusiasm for the utilisation of peat, refrains from directing attention to the more obvious defects in some of the schemes put forward, and leaves the capitalist in ignorance of facts which might materially alter the latter's relations to the projected industries.

The many attempts made within the past ten years to utilise our peat supplies have proceeded in three main directions, viz. the conversion of peat into fuel, the manufacture of power gas from peat, and the utilisation of peat fibres for the manufacture of paper, alcohol, moss litter, &c.

The chief difficulties attending the conversion of peat into fuel on a commercial scale are the removal of the large amount of water contained in freshly cut peat and the increase of the low specific calorific power, *i.e.* the calorific power of unit volume, of the fuel. The removal of the water by mechanical methods (hydraulic pressure, centrifuging, &c.), and also its removal by artificial heating, have been shown again and again to be unremunerative, and no process in which any of these methods forms a constituent part can, with normal prices prevailing for rival fuels, be regarded as economically sound. The only method for removing the water which has proved commercially successful is the method of air-drying employed by farmers for the production of their turf.

The specific calorific power of turf can be increased by converting the peat into press turf or into machine turf, but the difficulty of drying the product in a moist climate like that of Ireland, and the high cost of transport, render it unlikely that turf will displace coal as a fuel from any districts other than those in the immediate neighbourhood of peat bogs.

The manufacture of producer gas and its employment in industries such as the fabrication of glass, as well as the production of power gas and the recovery of the ammonia simultaneously formed, may under carefully selected conditions be made remunerative, but peat cannot, under any conditions likely to arise in the near future, become so cheap a source of energy as coal at the pit-mouth in England.

It is unlikely that the conversion of peat fibres into paper or into alcohol will prove successful commercially. From one ton of anhydrous, light, surface peat, by hydrolysis about 0·28 ton of reducing sugars can be obtained, and if the latter were all fermentable they would afford about forty gallons of alcohol. If this were the average yield of alcohol from peat the process would be very remunerative, but, unfortunately, about one-half the amount of sugars in hydrolysed peat consists of pentoses which are not capable of undergoing saccharomycetes fermentation, and consequently the yield of alcohol rarely exceeds twenty gallons per ton of dry peat; if surface peat is not employed in the manufacture, the yield may fall so low as five gallons per ton. If the yield of alcohol from a given specimen of peat falls below sixteen gallons per ton, the manufacture of "peat spirit" will be unable to compete with that of "potato spirit" owing to the greater value of the by-products in the latter industry. The peat moss-litter industry, on the other hand, is from the commercial point of view the most flourishing of all the peat industries, and is likely to prove as remunerative to the capitalist in the future as it has been in the past.

Hugh Ryan.

THE HEALTH OF THE SCHOOL CHILD.

The Hygiene of School Life. By Dr. Ralph H. Crowley. Pp. xiv+403. (London: Methuen and Co., 1910.) Price 3*s.* 6*d.* net.

In his preface to this work the author states that it was written while he was medical superintendent to the Bradford Education Authority, and that the conclusions arrived at and the measures advocated are based upon his own practical experience gained amongst the schools and school-children of that city. He furthermore states that the views expressed receive no added sanction from the fact that he now holds an official position in the Medical Department of the Board of Education. Although this may be so, it seems as if his present position is responsible (through the official non-committal attitude it has engendered) for the one outstanding deficiency of the book, namely, a lack of definiteness and of detail. For instance, one who consults a manual upon the hygiene of school-life might reasonably expect some definite directions upon the cleansing and disinfection of school premises; the measurements of seats and desks for children in different age groups, with the appropriate slope of desks for reading and writing purposes; the distances recommended between the hanging-pegs of cloak-rooms; but in these respects, as in so many others, he will find but generalities. Indeed, generally speaking, the work is sketchy, and requires the addition of fuller and often more definite information to become a useful addition to the already voluminous literature upon the subject of school hygiene.

It need scarcely be said that the matter given and the views expressed by one with the experience and knowledge of Dr. Crowley are sound, and that certain parts of the work reach a good standard of merit; more especially is this true of the chapters upon special groups of school-children. The chapter upon medical inspection of the child in the school is also very good, and it impresses upon the reader the fact that medical inspection, and all that it involves, has a part to play now and in the future, the importance of which can hardly be over-estimated. As Dr. Crowley states in his introduction, it is a service which stands out clear and well-defined, demanding of the medical men and women who perform it the highest qualifications and attainments. While essentially a part of the public health service, it is nevertheless a department which can never know its own full development until it recognises itself as a part of the whole public health service of the country, and links itself up and has an organic relation with that

service. Although it is some sixty years ago since a certain measure of medical inspection of school-children was initiated in Paris, and Great Britain has been so slow to adopt a provision the value of which has been appreciated by many other countries for many years, the work has been started in this country with such zeal and enthusiasm that we promise very shortly to have established throughout these islands a scheme which will compare favourably with that of any other country. But it is essential to the best results that there should be a better knowledge of the demands of school hygiene among medical men who are called upon to work in connection with the schools, and also among the teachers; and suitable manuals upon this subject are therefore of great value and importance. The present work is so suitable in many respects that it is to be hoped that in a future edition more explicit information upon many of the practical details of school hygiene, which are wanting in the present volume, will be included.

MODERN SCHOOL GEOGRAPHY.

(1) *Narrative Geography Readers.* By G. F. Bosworth. Book i., pp. viii+133; book ii., pp. viii+145. (London: Macmillan and Co., Ltd., 1910.) Price 1*s.* each.

(2) *A Systematic Geography of Europe.* By G. W. Webb. Pp. viii+96. (London: Methuen and Co., 1910.) Price 1*s.*

(3) *Narratives Selected from Peaks, Passes and Glaciers.* Edited by G. Wherry. Pp. iii+156. (Cambridge: University Press, 1910.) Price 1*s.*

(4) *Cambridge County Geographies: Cheshire.* By T. A. Coward. Pp. x+207+maps. (Cambridge: University Press, 1910.) Price 1*s.* 6*d.*

(5) *An Elementary Practical Geography for Middle Forms.* By F. Mort. Pp. 91. (London: Blackie and Son, Ltd., 1909.) Price 2*s.*

(6) *A School Economic Atlas.* By Dr. J. G. Bartholomew, with Introduction by Prof. L. W. Lyde. Pp. xii+64. (Oxford: The Clarendon Press, 1910.) Price 2*s.* 6*d.* net.

A SET of new school books in geography suggests the possibility of finding from an examination of their contents the main lines along which instruction in this subject is tending at the present time to crystallise.

With a single exception the books named above differ considerably from those in school use ten to fifteen years ago: they suggest development in three directions, the first being that of the story told to beginners, the others, for older pupils, being the scientific methods of actual investigation by the pupil from the raw material of geographical records, and of considering the results of special study as placed together in a monograph, if such a word may be used in this modest connection, or of considering the actual experiences described by the traveller.

The single exception, Mr. Webb's "Systematic Europe" (2), recalls the old type of text-book, with its tit-bit collection of facts, of which the following is a specimen:—"Elche is famous for its date palms" (p. 32). Less than one-fifth of the book is given to a general survey of the Continent, and the remainder is a fairly systematic treatment of the separate countries. Many of the facts seem to be unimportant; others are such as a good pupil might reasonably be expected to find out for himself from a modern atlas, provided he had had some little training in investigation. The attempts in the large-type matter to trace causal connections are not always happy, as, for example, in regard to the Gulf Stream, which is described as washing the western shores of Scandinavia, and to the Föhn effect, which is called a wind.

The "Narrative Readers" (1) set forth, in the first place, facts concerning the lives of children in other lands, and from the stories of their habits and surroundings the author passes to the stories of such interesting things as the whale fishery, Captain Cook's voyages, or the mutiny of the *Bounty.* The child is frequently referred to an atlas, but it would probably be better if the reference were to a globe which could be presented as a model of the earth.

At a certain stage of development it is more important that the child should be able to do things for himself than that he should memorise facts presented to him by an adult; and it is probable that no school subject provides a means for work of this nature so easily and so universally available as geography, hence the development of practical work in this subject. For this the main requirement is a good atlas, and the Clarendon Press is to be congratulated that the first venture in the provision of an atlas is one so likely to be largely adopted as the one under review (6). The child who works through the ample supply of material in the spirit outlined in Prof. Lyde's introduction will be well equipped as a thinker in terms of geography. From the point of view of scientific accuracy it would perhaps be helpful if some numerical values were added to the statistical diagrams relating to the main products of economic importance, and also that the values given should be either triennial or quinquennial averages; possibly future editions will be improved in these directions. Many additional facts are given in the introduction in a concentrated and technical language, presumably for the benefit of the teacher.

Before such an atlas can be used the pupil should have had some preliminary training in the making of similar maps, and for this purpose are provided for schools those books of practical geography of which Mr. Mort's is one example. Although it deals with contouring, with climate, and with vegetation, this book illustrates markedly the indefiniteness of the boundaries of school geography, for some of the earlier work suggested should probably be called observational nature-study, while much of the plane-tabling is surveying work which would, to many teachers, appear to be beyond the scope of a school course. Mr. Mort's book is not entirely "heuristic," as he tells many facts which the pupil might be expected to find out for himself.

It is not possible in practical exercises of this nature to cover the entire ground of geographical studies, and therefore the pupil is provided with two other kinds of text for reference or special study. The first

contains narratives by actual travellers, such as those edited by Mr. Wherry (3); these can be used as school readers, or can be set for home reading; this particular set deals with early climbs in the Alps. The second kind takes the form of a special study of a limited area, and the volume on "Cheshire" (4) illustrates the way in which the pupil may be brought into touch with the work of a specialist; such books should be in the geographical reference library. These works appear to typify the best efforts of modern teachers of geography.

B. C. W.

ELECTRICAL ENGINEERING.

(1) *Electrotechnics.* By Dr. John Henderson. Pp. xiv+165. (London: Longmans, Green and Co., 1909.) Price 3*s.* 6*d.*

(2) *Practical Testing of Electrical Machines.* By L. Oulton and N. J. Wilson. Pp. vi+210. (London: Whittaker and Co., 1909.) Price 4*s.* 6*d.* net.

(1) THE efficient organisation of students' work in an electrical engineering laboratory is a difficult task, and especially so with large elementary classes. Advanced students may be trusted with delicate instruments and left to arrange the necessary connections by themselves, they require little supervision, and as their number is small this is easily given. With elementary classes the case is different. It is obviously impossible to let all the men do the same tests simultaneously, since that would require multiplication of apparatus beyond the financial capacity of most institutions. Hence tests of different kinds must go on at the same time, and since the demonstrator cannot personally supervise every one of these different tests from its beginning, it is important that the students should get very clear instructions in print. It is also important so to arrange the tests that they shall, with students of average ability, take about the same time, and to arrange the work generally with the precision of a railway time-table, because otherwise students will drop out of their order and fail to get the full benefit of the course. All this, and the necessity to adapt the work to the class of students attending and to the equipment which happens to be available in any particular institution, tends to make the instruction somewhat cut and dried in character, and this is likely to detract from its educational value.

The author, who has evidently experience of these difficulties and the way to make the best compromise possible between conflicting requirements, has, in the third volume of this series of physical and electrical engineering laboratory manuals, given us an excellent guide to laboratory work of this kind. He does not believe in the use of special apparatus, but very rightly teaches his students to make the tests in the laboratory very much in the same way that they will have to adopt when they get into practical life, that is, by the use of ordinary commercial instruments. He also adopts the principle that tests must be so arranged that only two, or at the outside three, men are necessary for any one test.

The subject-matter is divided into three parts, which roughly correspond to the City and Guilds of London syllabus for the "elementary stage" and the "ordinary grades" of direct and alternating current engineering. We thus get in the first part Ohm's law, the Wheatstone bridge, calibration of instruments, fuse testing, some simple magnetic tests, and experiments with a small motor. In the second part we come to heating of wires, potentiometric measurements, more advanced magnetic testing, characteristics of dynamos, secondary batteries, photometry, losses in dynamos, and so on. The third part deals mainly with the fundamental relations of alternating currents, graphic methods of representing these, and some very simple tests on alternators. Transformers and motors are not dealt with.

In an appendix are given mathematical and physical tables which will be found very useful, not only by the student, but also by the practical engineer. So far as the student is concerned, some of these tables should bring home to him a sense of reality of his work. Students are apt to consider their class-work as something purely scholastic and detached from practical life. If, then, a student, after having in his work found some physical fact such as the fusing current of a certain wire, the E.M.F. of a given cell, or the power per candle required by, say, an Osram lamp, and then turns to the tables at the end of this book to see how his determination agrees with the figures there given, he must get the impression that what he has done in the laboratory has practical importance, and this conviction will give him additional interest and pleasure in his work.

(2) This book is intended as a guide in testing electrical generators and motors. In the preface the authors point out that it is impossible to give "all the theory that the subject entails," and that the reader must therefore also consult some of the many textbooks. This is obviously right; nobody can expect to find in a book which is primarily an instruction how to test the whole of the theory of electrical machines, but some fundamental theories must be given, and in this respect the book falls short of what the reader has a right to expect. The authors give some sort of theory, but it is neither closely reasoned nor always clearly expressed. The latter defect may to some extent be due to their adoption of some terms which give one the impression of being a kind of technical jargon employed in a particular shop or laboratory, though not generally found in scientific books. For instance, if we are told to take a "locked saturation" it is not immediately obvious that we have to determine the relation between starting torque and voltage of an induction motor; nor is it very clear what a "pressed down reading on the scales with the power off" might mean. On p. 34 we read that "C.B. is the leakage current and proportional to the current in the motor." Further that it is "required to overcome the counter E.M.F. due to leakage."

These are of course merely unfortunate ways of expressing certain ideas which the authors have correctly in their minds, but it is irksome for the reader to have continuously to exercise his ingenuity in order to find out what it is the authors really mean. In some cases this task looks almost hopeless, as, for

instance, when on p. 7 we find that for a star-connected motor the "total current" is $\sqrt{3}$ times the current per phase, and on p. 8 we read that the "total current" is $\sqrt{3}$ times the "current per terminal." What the authors may mean by their term "total current" is not otherwise explained, and the reader can only surmise that it is merely a conventional way of introducing a current which is proportional to the line current. The introduction of such a conventional term is, however, quite unnecessary, as is also the introduction of the term "apparent efficiency" (p. 30), which has no physical meaning, since it is the ratio of voltamperes, which is not power, to watts, which is power. The authors also distinguish between "real horse-power" and "brake horse-power," and thus give the reader the idea that brake-power is not real power, whereas they merely mean to distinguish between the electrical power input and the mechanical power output of a motor. This is quite clear from the text, but why puzzle the reader by using new or misapplying old terms?

The efficiency tests described are all direct, that is to say, input and output are measured and their ratio calculated; the authors think this less inconvenient than some method of determining efficiency by the measurement of lost power, or, as they call it, the "loading back" method. This may be true so long as one has to deal with very small machines, but most practical engineers prefer to test large machines by some differential method. One counsel given by the authors should be followed in testing every kind of machine, namely, to plot results as the test proceeds, so that doubtful observations may be eliminated before the test is finished and the apparatus dismantled. The tests described comprise a 50-horse-power induction motor, a 500-kilowatt generator, a 300-kilowatt rotary converter, a 75-horse-power single-phase railway motor, a 450-kilowatt direct-current generator, a 40-horse-power direct-current motor, and an enclosed railway type of motor of only 12 horse-power. These tests are explained very fully, and the results are given in tables and curves, which are carefully compiled. The reader having once accustomed himself to the authors' peculiar nomenclature (such as "rack" for rheostat, and the terms alluded to in the first part of this review) will find no difficulty in following the sense of the text, and will derive some benefit from the book by following the examples given if he has to make similar tests.

GISBERT KAPP.

THE PHYSIOLOGICAL ANATOMY OF PLANTS.

Physiologische Pflanzenanatomie. By Prof. G. Haberlandt. Vierte neuarbeitete und vermehrte Auflage. Pp. xviii+650. (Leipzig: W. Engelmann, 1909.) Price 19 marks.

THE first edition of Prof. Haberlandt's well-known work appeared in 1884, so that (as the author points out) it has already reached a respectable antiquity, as the age of scientific text-books is reckoned. But, even before 1884, Haberlandt was beginning to be known for researches of a kindred sort, *e.g.* in the protective adaptations in seedlings (1877), and on the relation between structure and function illustrated by the assimilatory tissues (1880). By persistent work in this general direction he has made himself the recognised authority on "physiologische Pflanzenanatomie." Haberlandt dedicated his first edition "mit dem Ausdruck freundschaftlicher Verehrung" to Prof. Schwendener.[1] This was appropriate, because it was Schwendener, in his celebrated work, "Das mechanische Prinzip, &c.," who "raised anatomico-physiological research above the level of casual tentative experiment, and marked it out, once for all, as a definite department of science."[2]

Structure in relation to function is an old subject of inquiry, but it was pursued on theological rather than on scientific lines before the publication of the "Origin of Species," and Haberlandt's work is the direct outcome of that book. At first, however, adaptation was principally studied in the external characters serving for fertilisation, dispersal of seeds, &c. The meaning of histological peculiarities was neglected, or strangely perverted, as, for instance, in the comparatively recent dogmas that vessels do not serve as water-pipes, or stomata for gaseous exchange. Schwendener's work showed, in the most unexpected and brilliant way, the value to the plant of such a neglected point as the sectional outline of its mechanical tissues. After this the study of adaptation could not be confined to obvious macroscopic points, and Schwendener's work led up to the classification of tissues according to their physiological character, which forms the basis of Haberlandt's book.

Since the first edition (1884), Haberlandt's book has flourished and increased, as may be shown by the simple process of counting the pages. Edition i. contained 398 pp.; edition iv. 650 pp. Edition i. had 139 figures in the text, and these have increased to 291. This represents the legitimate growth of the subject, and it is to be noted that Haberlandt, from the extent of his own work, is well fitted to make use of the researches of others. Huxley has well said that only a man who knows the raw material of science at first hand can judge of the amount of "speculative strain" that the elements of a given problem will bear. It is this sort of knowledge that makes Haberlandt an admirable critic and exponent of the work of others.

If we compare the present volume with the first edition, the most striking point in which the modern book differs from its ancestor is the presence of a chapter on sense-organs." Botanists will be glad to have, in a compass of 50 pp. or so, a full discussion of the scattered controversies on this subject. Haberlandt's statolith theory of the sense-organs for the perception of gravity, and of the lens-function of the epidermis in relation to heliotropism, are the most speculative of his views, and are by no means universally accepted, but the most sceptical can hardly refuse to admire the skill with which these exciting hypotheses are upheld.

F. D.

[1] The present dedication bears the additional words "on the completion of his 80th birthday."
[2] Haberlandt's preface to his first edition, p. viii.

OUR BOOK SHELF.

The Fauna of British India, including Ceylon and Burma. Edited by Dr. A. E. Shipley, F.R.S. Dermaptera (Earwigs). By Dr. Malcolm Burr. Pp. xviii+217; 10 plates. (London: Taylor and Francis; Calcutta: Thacker, Spink and Co., Ltd., 1910.)

This half-volume is the first addition to the "Fauna of India" published since the regretted death of Col. Bingham; and Dr. Shipley, the new editor, reviews the arrangements made for forthcoming volumes in progress.

Dr. Burr, since the death of De Bormans, has made himself the recognised authority on the small and hitherto somewhat neglected order Dermaptera or Euplexoptera, often treated as a family (Forficulidæ) of the Orthoptera, and is at present engaged on a monograph of the earwigs of the world, of which the present volume may be regarded as an excerpt.

It is not many years since the total number of Forficulidæ described from all parts of the world was less than a hundred. Earwigs are not insects that are assiduously collected, or always easy to find, if not specially searched for; but in the present work Dr. Burr enumerates 135 species for British India alone, divided into 51 genera, 14 subfamilies, and 5 families. He treats the earwigs as a distinct order, under the name Dermaptera.

The author's preface relates chiefly to types, and to the various sources supplying material for this work. By an oversight, the British Museum, to which Mr. Burr has always had free access, is not alluded to in this connection, though in the table of species at the end of the introduction a column is devoted to indicating those in the national collection. The main part of the introduction is devoted to structure and habits, and is of great value, and the bibliography is also tolerably full; but we notice one extraordinary error under Westwood—"Rözel's Himalayas" for "Royle's Himalayas."

The technical part of the work is executed in the usual manner of the "Fauna Indica." The appendices offer us instructions for collecting and preserving earwigs; abbreviations of authors' names; and a useful glossary of terms. Of the ten plates, the tenth only is in colour; and there are sixteen text-figures representing various structural details.

Longmans' Wall Pictures. Flowers, Butterflies, and Moths. By Archibald Thorburn. Ten plates, each plate 2*s.* 6*d.*; set of ten plates in portfolio, 1*l.* 10*s.*

Descriptive Notes for Teachers, for use with Longmans' Natural History Wall Pictures. Notes on Flowers. By C. J. Longman. *Notes on Butterflies and Moths.* By W. S. Furneaux. Pp. 30. (London: Longmans, Green and Co., 1910.) Price 6*d.*

The attractive set of wall pictures published under the above title consist of ten coloured plates, reproduced from water-colour drawings by Mr. A. Thorburn. On each plate, measuring 18 inches by 14 inches—with the cardboard mount, 25 inches by 20 inches—two plants and two butterflies or moths are depicted. The series follows a monthly sequence according to the appearance of the butterflies and the flowering of the plants; one plate is allowed for April and May, and two plates for each month from June to September. So far as the plants are concerned, an ecological basis also exists; thus the April flowers, the primrose and bluebell, are denizens of woodland, the poppy and bluebottle are agrarian, and the purple loosestrife and water-mint are typical marsh plants. The butterflies represented are Fritillaries, Blues, Peacock, Red Admiral, and other common species. The pictures are very effective, as Mr. Thorburn has combined artistic rendering and setting with correct form and colour of the plants; the reproduction, too, is fully satisfactory, so that they form a most decorative series, eminently suitable for display in class- or schoolroom.

The descriptive notes to accompany the plates are useful, especially the descriptions supplied by Mr. Furneaux of the caterpillars which are not illustrated. The botanical notes present the systematic position of the plants, but do not sufficiently emphasise the ecological aspect; there is also correction required in the explanation of radical leaves and flowers.

Formation of Character. By Rev. J. B. S. Watson. With a Preface by Rev. G. P. Merrick, and a Foreword on Industry by Andrew Whitlie. Pp. 115. (London: H. R. Allenson, Ltd., 1908.) Second edition. Price 1*s.* 6*d.* net.

This handy little volume consists of pithy and stimulating addresses on such subjects as courage, temperance, industry, reverence, and the like. The author is chaplain of H.M. prison at Brixton, and has had exceptional opportunity for observing the disastrous result of lack of moral discipline and deliberate character-training in youth. He is strongly of opinion that between instruction in "religious knowledge" and the usual branches of secular education, instruction in manners and morals is apt to be neglected. Mere stuffing with knowledge is not culture, and the "religious" knowledge is too often a dead and dry acquaintance with almost meaningless metaphysical formulæ. There is much to be said for the contentions of the Moral Instruction League. Character is the important thing—not creed or dogma.

The book is just the thing to put into the hands of boys and youths, and will be interesting and helpful to teachers also. It contains a short preface by the Rev. G. P. Merrick (formerly Chaplain-Inspector of H.M. Prisons), and a foreword on industry by Mr. Andrew Whitlie, of the Commercial Bank of Scotland, London. A thousand free copies have been distributed to sailors by the chaplain of the Port of London, thanks to the generosity of T.R.H. the Prince and Princess of Wales and other subscribers.

Simple Jewellery; a Practical Handbook dealing with certain Elementary Methods of Design and Construction, written for the use of Craftsmen, Designers, Students, and Teachers. By R. Ll. B. Rathbone. Pp. xiv+280. (London: Constable and Co., Ltd., 1910.) Price 6*s.* net.

This is a useful manual which cannot fail to prove of great service to amateurs. It is mainly devoted to describing the methods of designing and making gold and silver ornaments from grains and wire, both round and flattened, nearly a hundred illustrations of such designs being given. Artistic questions chiefly occupy the attention of the author, but we notice some judicious remarks on the employment of acids in "pickling," while the instructions in the methods of using the blowpipe in "soldering" are very detailed and practical, being based on scientific principles.

Le Tremblements de Terre. By Dr. G. Eisenmenger. Pp. 187. (Paris: F. Alcan, n.d.) Price 60 centimes.

Some recent earthquakes, such as those of San Francisco, Valparaiso, Messina, and Provence, are described in vivid and popular language. The phenomena of earthquakes, their classification, causes and distribution, and the possibility of predicting their occurrence, are briefly considered. A book so cheap as this, if the facts were accurately given, would be useful at a time when the interest in earthquakes has become general.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Colour of Water and Ice.

I HAVE read with much interest Sir Ray Lankester's letter on the colour of water in NATURE of March 17. I remember discussing this same problem in the case of ice with Sir Joseph Thomson when we stood at the foot of the great glacier at Glacier, B.C., during the western excursion of the British Association last summer. The rich blue colour of the hard, clear ice was remarkable, even in quite small pieces. The same blue colour is noticed when surface-ice, which has been formed slowly by conduction, is taken out of the St. Lawrence River. The blocks lose their colour when they are exposed for long to the light, and especially rapidly when exposed to sunlight. Coloured sediment and air cavities in the ice detract from the colour. I am inclined to believe that the colour of ice is a real absorption effect, due to the large molecular aggregates forming the structure, which absorb the long rays, and not a "blue sky" effect, as I suggested after seeing the blue ice of the glacier.

In the case of water, all the physical properties indicate the presence of complex molecular aggregates in solution, which become gradually reduced in number as the temperature rises. Thus the variation of specific heat, of density, of viscosity, and compressibility, all disclose an effect due to a gradual diminution of the molecular aggregates. I believe these are the same as the ice molecules, and constitute the absorbing medium which gives water its blue colour. Sea-water is particularly blue, and here we probably have added the effect of the salt molecules, in addition to the fact that the water is very clear.

Mr. W. H. Sherzer has shown (Smithsonian Report, 1907) that the blue colour of the water and ice of the glaciers of the Canadian Rockies is a real absorption effect. The blue colour is increased by the presence of minute white sediment, but not by coloured sediment.

If it has not been already tried, it would be very interesting to see what effect temperature has on the greenish-blue light transmitted through very pure water. If the colour is due to the presence of ice molecules, it should grow less as the numbers are reduced. I cannot help thinking of the beautiful blue colour of liquid air as soon as most of the nitrogen has boiled away; if this were due to the presence of complex oxygen molecules, such as ozone, it would be somewhat similar to water.

H. T. BARNES.

McGill University, Montreal, March 29.

Centre of Gravity of Annual Rainfall.

THE question whether Mr. Cook's suggestions in NATURE of March 31 have a practical value can be very simply settled. It is proposed to consider the month to month rainfalls at a place as a series of parallel forces, $p_1, p_2 \ldots p_{12}$, say, where the distance (X) from the beginning of the year of the corresponding "centre of gravity" is given by

$$X = \frac{p_1 + 2p_2 + \ldots + 12p_{12}}{p_1 + p_2 + \ldots + p_{12}}.$$

Now, if we assign arbitrary values to any ten, say, of the p's (and these ten p's could be selected in sixty-six ways), then, the position of the C.G. remaining the same, we have obviously a single linear equation in two variables to give us the values of the two remaining p's, and this equation can be solved in an infinite number of ways. Thus the same C.G. can be given by an infinitely varied arrangement of sizes of the p's, and therefore its position gives no indication whatever of the monthly distribution of the rainfall of the places referred to.

To illustrate by three simple examples. The absolute value of the elements is of no importance, and taking for convenience a rainfall of 36 inches, we might have the three following distributions:—

	A	B	C
	in.	in.	in.
January	3	0	12
February	3	0	4
March	3	0	2
April	3	6	0
May	3	6	0
June	3	6	0
July	3	6	0
August	3	6	0
September	3	6	0
October	3	0	2
November	3	0	4
December	3	0	12
Total Rainfall	36	36	36
C.G.	6·5	6·5	6·5
Rainfall Moment	234	234	234

Thus A, B, and C have the same annual rainfalls, the same C.G., and the same "rainfall moment." The question whether or not the seasonal distributions correspond to those of actual places on the earth's surface is not to the point, though, as a matter of fact, C approximates to the typical Levantine curve.

Thus places with very different rainfall distributions may have the same C.G. and the same rainfall moment, and the proposed method of comparing the rainfalls of various places appears to have neither a theoretical nor a practical value. The method may possibly have a certain critical value in comparing the yearly variations at a particular place, where there is but little change in type from year to year, and especially in such a country as India, where the seasonal rainfalls are exceptionally well marked; but this seems doubtful, and in any case the method could be used only in conjunction with the actual monthly values.

ANDREW WATT.

Scottish Meteorological Society, Edinburgh, April 6.

Certain Reactions of Albino Hair.

UNDER this heading in NATURE of March 24 (p. 96) Miss Igerna Sollas referred to some experiments of mine upon the hair of albino rats, in which she failed to obtain one of the reactions described in my note (Proc. Physiological Soc., March 27, 1909). It is, of course, not improbable that different albino rats may carry different chromogens, and that some of them may lack the one which, when oxidised with H_2O_2, gives a brownish colour. On the other hand, the failure may be due to the presence of some of the formalin, which may not have been completely washed away from the previous reaction.

There is one new observation which I should like to record here, since it bears upon the H_2O_2 reaction. The action of H_2O_2 is an oxidising one, and the production of a brownish tint may be interpreted as due to the oxidation of a colourless chromogenous body present in albino hairs. If this interpretation is right, other oxidising agents should produce a similar tint. During November of last year I casually placed two dead albino rats upon the top of one of my cages, these latter being kept out of doors. The rats were forgotten, and left exposed to the air for about a fortnight. During this interval the weather had been wet and warm for the time of year. Upon discovering them at the end of this interval, I noticed that on both rats the upper side, and part of the belly and back, had assumed the same sort of brownish tinge that H_2O_2 produces. The under side of both rats, which had been protected from the wet and light by its contact with the cage, was quite white. It thus seems possible to oxidise the chromogenous substance ostensibly present in albino rats by the oxygen of the air in the presence of continuous moisture. I do not think that light played much part in the reaction, since throughout this period it was very dull weather.

The mention of light brings me to another point in Miss Sollas's note. She says that prolonged immersion in the

formalin fluid results in the destruction of the colour. I am inclined to think that this destruction does not depend upon the solution, but is due to the action of light. I noticed the same thing in my experiments; but, in addition, I was enabled to observe—because I kept my rats in flat vessels standing on a *blackened* bench—that it was only the upper surfaces exposed to rather bright sunshine that thus faded. The under surfaces remained as brilliant a yellow as before. To confirm this conclusion I placed all my rats, still immersed in the solution, in a dark cupboard, and the partially faded colour somewhat returned, but not, I think, quite to the same intensity as originally. So long as I kept them in the dark the colour was retained. Whether this would be so indefinitely I should not like to say; but certainly it lasts for several months.

The yellow tinge assumed by some albino rats is, I think, not a phenomenon of light action, as Miss Durham, quoted by Miss Sollas, seems to imply, so much as one due to age. It is possibly a manifestation of diminished metabolism and lessened oxidation. Of the several hundred albino rats which I have bred, I do not remember any within their first year showing this yellow tinge, while it has been a frequent observation that old rats (after about the first year), though they were kept in semi-darkness, manifested a very obvious yellow colour. I do not wish to commit myself to this as a positive statement, for I made no scientific records of the matter. I am speaking from general impression alone; but it is certain there is a marked contrast between the pure white hairs of young rats, about six to eight weeks, and those of some twelvemonth or older rats, all living under the same conditions as regards light.

With regard to Miss Sollas's experiments with the skins of guinea-pigs and with that of a single mouse, there are several considerations of interest that suggest themselves. Miss Sollas found, as I did, that albino mice give a negative result with formalin; but I subsequently found (Proc. Physiological Soc., October 23, 1909) that if piebald mice are treated with 5 per cent. nitric acid in 75 per cent. *spirit* and are placed in the dark, in about five days most of the white areas of the pelage turn to a beautiful rose-pink colour. The same is true of albino mice. These experiments were performed in the summer; but during one cold week last winter I repeated the experiment on a single black piebald mouse, and the colour-reaction failed to appear. Upon placing the vessel containing the solution and mouse in an incubator at 102° F., the rose-pink colour appeared. The dependence of this colour-reaction upon temperature is confirmatory evidence that the phenomenon is one of ferment action.

It would be interesting to see if guinea-pig skins, which fail to respond to the formalin reagent, would do so with the nitric acid. GEO. P. MUDGE.

Biological Department, London Hospital Medical College, E.

The Electrification of Insulating Materials.

SOME time ago, while endeavouring to get a trustworthy method of producing static charges in a humid atmosphere, I had occasion to experiment with celluloid. Rolled celluloid sheet with the surface burnished was found very suitable. If a "tassel" be made of this material by cutting up a small piece of thin sheet into narrow strips, then by simply placing the "tassel" on a table and stroking with the fingers, strong electrification is produced. On raising the "tassel" the strips diverge, and remain divergent in a most striking manner.

A further curious effect was observed, that if two narrow strips of celluloid were rapidly pulled between the fingers they were both electrified, one of the surfaces in contact being positive, the other negative. At first no consistent results were obtained that might lead to an explanation of the phenomenon; some found the top strip always positive, some the bottom strip when the pieces were held horizontally. Later, however, Mr. M. McCallum Fairgrieve, of Edinburgh Academy, noticed that the order of electrification depended on whether the strips were bent upwards or downwards when pulled in a horizontal direction through the fingers. This seems to be the true explanation. Of the surfaces in contact, one is in compression, the other in tension; with celluloid the compressed surface is always negatively, the stretched surface positively, electrified. The effect is very apparent if the two strips are pulled slowly between the first finger and the thumb, and the strip in contact with the thumb will be + or − according as it is concave or convex to the thumb.

Of other substances investigated, paper, vulcanite, and shellac have the same property, and mica to a lesser degree.

I propose to investigate the phenomenon further, particularly with relation to electrification by compression and cleavage. In the meantime, I have made a small electrical machine in which three endless bands of celluloid run over pulleys. Suitable collectors are provided, and considerable + and − charges may be obtained. The charges are no doubt produced by the combined pressure and bending, as already explained.

WALTER JAMIESON.

Provanside Higher Grade School, Glasgow.

Effect of Varying Temperatures upon the Colour and Growth of Fur.

THE following may be of interest to readers of NATURE. Some time ago an ordinary all-black cat was accidentally shut up in a refrigerating chamber on one of the Orient Line mail steamers when the vessel was in Sydney Harbour. The chamber was not opened until the ship was off Aden, which is about thirty-two days out. When the cat was brought out it was scarcely recognisable. Its coat had become long and thick, and the fur on its back was nearly white. It had lost one ear through frost-bite.

The change in the cat's environment from the intense frost of a refrigerating chamber to the intense heat of the Red Sea was accompanied by a rapid change in the cat's appearance. The heavy white coat rapidly fell out, and by the time the ship reached London the cat had practically regained its normal appearance.

I did not see the cat, but have inquired carefully into the statements, and have had their truth vouched for by one of the directors of the Orient Company.

A. CAMPBELL GEDDES.

Royal College of Surgeons in Ireland, Dublin, April 6.

April Meteor Showers.

IN the present year there is likely to be a greater amount of meteoric activity about April 18–19 than, as might be expected, a few days later. There will then be an interval of quiescence until April 26. Between the latter date and the end of the month several important displays become due. The following are details of the most interesting showers, as calculated by the writer, that occur during the period April 12–30:—

Epoch April 19, 14h. 30m. (G.M.T.), shower of second order of magnitude. Principal maximum April 18, 22h. 18m.; secondary maxima on April 19 occur at 1h. 12m. and 9h. 25m.

Epoch April 27, 21h. 50m., shower of twenty-third order of magnitude. Principal maximum April 26, 16h. 26m. On April 26 there are also secondary maxima at 5h. 20m. and 18h. 55m., and another on April 27, 6h.

Epoch April 28, 11h. 15m., shower of fourteenth order of magnitude. Principal maximum April 30, 4h. 25m. There is a secondary maximum on April 28, 17h. 30m., and two others on April 29, at 12h. and 20h. 20m.

Epoch April 29, 12h., shower of fourth order of magnitude; the principal maximum becomes due about April 28, 12h.

While there are three meteor showers that fall between April 26 and the end of the month, there is only one of any importance during the period April 12–25. In some respects this earlier isolated display is the more interesting, however, owing to its being of greater intensity than the others, and of a somewhat different character.

Dublin. JOHN R. HENRY.

THE BASUTO.[1]

SIR GODFREY LAGDEN has given us, in these two volumes under review, a valuable history of the rise of the Basuto nation in the Switzerland of South Africa, under the leadership of a great man—Moshesh.

The Basuto, under the sway of this remarkable personage, were for the most part compounded of clans of the so-called Bechuana peoples, yet the root of their present national name—Suto (the Ba- is merely the plural prefix)—seems to have been derived from the same tribe or district of north-eastern Zululand (Ama-sutu, Usutu) as that which gave rise to the present royal dynasty of the Zulu people, to which Cechwayo belonged. No doubt it sent other enterprising adventurers farther west. By one of these was founded the Ba-suto clan from which Moshesh arose, in the circumstances cited by Sir Godfrey Lagden on p. 19. Moshesh was not directly descended from the stock of some bygone Zulu adventurer, whose tribal name—Suto or Sutu—had been adopted by these Bechuana people, but from a distant relative of the same racial origin whose ancestors had remained in the Amahlubi country to the south. The grandfather of Moshesh, however, had been adopted as a son and successor by Sekake, a Bakwena chief (apparently descended on one side from the original Umu-sutu). This adopted son was called Pete. He was succeeded by his own son, Mokachane, who was the father of Moshesh (this name as it stands means "a woman's garment" in the Se-suto language, but Sir Godfrey states that it is more probably an abbreviation of "Mosheshwe," which he interprets as "shaver" or "leveller"). The birth of Moshesh must have taken place about 1792, at Monkhoaneng, in Northern Basutoland.

About 1815, Chaka obtained complete control over the Zulu Kafirs of Zululand and Eastern Natal, and commenced that series of bloody wars in which, at the lowest possible estimate, a million Bantu negroes perished: wars which started a series of convulsions amongst the negroes of South Africa, that only came to an end by the death of Lobengula in 1894, the capture of Gungunyane by the Portuguese in 1895, and the complete subjugation (by force and by diplomacy) of the Angoni Zulus of Western Nyasaland by Sir Alfred Sharpe in 1906.

Wave after wave of Kafir or Zulu invasion of Basutoland took place after 1820, and, but for the mountainous character of Basutoland and the valour and genius for warfare of the Boers, not even Moshesh could have saved the remnant of the southern Bechuana peoples who gathered round him. But he found in Thaba Bosigo—the "Mountain of Night," under the shadow of Mount Machache, in north-western Basutoland—a stronghold from which no force—black or white—ever availed to dislodge him. The Zulu conqueror, Moselekatsi, might, perhaps, have succeeded (in spite of one severe repulse) in taking Thaba Bosigo and establishing a secondary Zulu power in Basutoland (about 1832), but he could only have done this by surrounding the mountain and gradually starving out the Basuto clan. This purpose, even if he entertained it, was thwarted by the action of the emigrant Boers, who, by means of their firearms and system of laager camps (a defence of linked wagons), defeated Moselekatsi and drove him permanently beyond the Limpopo River.

Thus it was mainly the action of the white man which enabled the Basuto clan of the Southern Bechuana to expand into the Basuto nation. The emigrant Boers, after soundly thrashing Moselekatsi, saved from complete extermination the Bechuana peoples between the Kalahari Desert and Lake Ngami on the north and the Drakensberg Mountains on the south. The emigrant farmers themselves occupied, in the first instance, the less mountainous elevated plateaus to the north of the Caledon River.

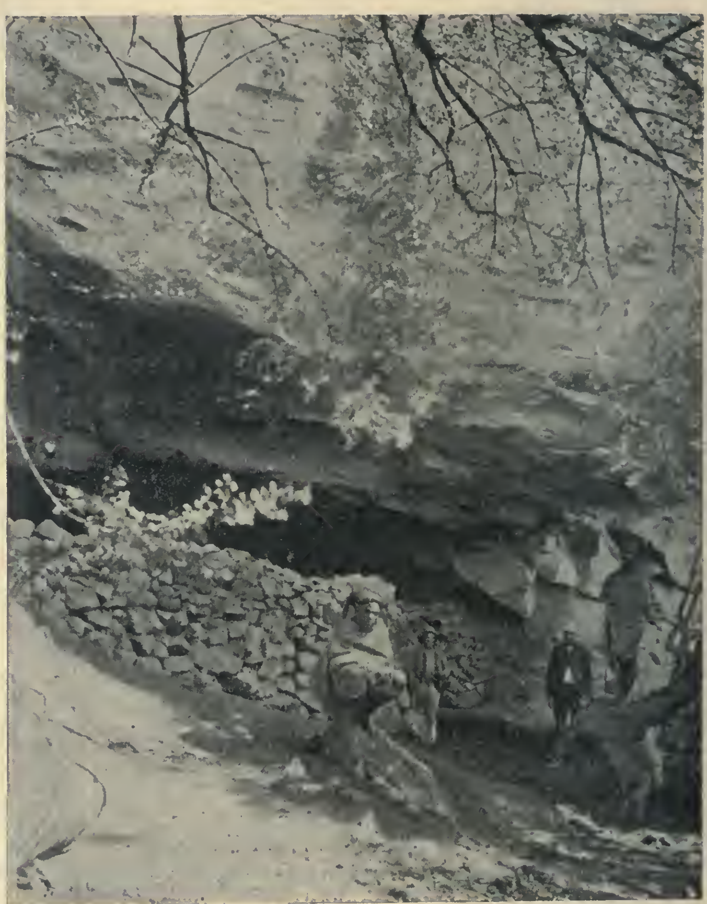


Photo. by T. Lindsay Fairclough]

Fig. 1.—Fortified Cave at Lebise Masupha's Berea. From "The Basutos."

But although Moshesh and his Basuto received the first missionaries (1833) gladly, and practically at no time put any opposition in the way of the spread of Christianity and education, they strongly objected to the Boers as settlers in what is now the Orange Free State. They wished to learn the wisdom of the white man, and, above all, to acquire his firearms and his horses (early in the 19th century they had begun that affection for the horse which has resulted in the re-

[1] "The Basutos; the Mountaineers and their Country." By Sir Godfrey Lagden, K.C.M.G. 2 vols. Vol. i., pp. xvi+338; vol. ii., pp. xii+339–690. (London: Hutchinson and Co., 1909.) Price 24s. net.

markable breed of Basuto ponies and the creation of a Basuto cavalry that has been, and will be, no negligible quantity in the forces of South Africa). Moshesh and his descendants, as soon as they saw a chance, entered into friendly relations with Moselekatsi in the far north, and his son Lobengula, with the kings of Zululand, and the more powerful clans of British Kaffraria and Northern Natal. In fact, no sooner were they relieved from the menace of Zulu conquest by the action of the Boers than they strove by many subtle means to push the white man as far away as possible from the centre of South Africa.

Their dislike of the British was quite as great as their dislike of the Boers. Between 1840 and 1852 Moshesh and his chiefs made use of the British power to stave off a Boer conquest of their country. After that they attempted an aggressive attitude towards even the British, and inflicted on the soldiers of Sir George Cathcart a very serious repulse. From 1858 onwards they fought intermittently with the Orange State Boers (the Basuto being the aggressors), until at last, getting worn out in the struggle with these dogged white men, they invoked British protection in 1868. They were annexed as a Native State to the government of Cape Colony in 1872, but an attempt to disarm them brought on a fresh outbreak of warfare, in which the Cape forces gained no laurels and General Gordon's intervention proved futile. In 1884 Basutoland was disannexed, and has henceforth been directly controlled by the Imperial Government.

[*Photo. by Capt. French.*

Fig. 2.—Ketane Falls and Gorge. From "The Basutos."

Since 1884, when the native negro population of this State (which is nearly the size of Belgium) amounted to about 170,000, the total number of the Basuto has risen to nearly 400,000 at the close of 1909. Education, under French Protestant and British Wesleyan missionaries, has made considerable strides. The country, in fact, is so prosperous that it is becoming a factor of increasing importance in the problem of South Africa. Basutoland (the reviewer thinks) should have been made—if the advice of the one or two statesmen-governors of South Africa had been listened to in the first half of the 19th century—the Empire State of South Africa, the principal stronghold in all that region of the white race; and ample territories farther north or farther south might have been allotted *then* to the few thousand Basuto, who asked for little more at that period than peace, security, and an inalienable right to a reasonable amount of land. Now, as things are constituted, Basutoland is emphatically a black man's country,[1] and from Basutoland radiates a vigorous impulse which will go far towards securing for the black man eventual terms of equal partnership with the white in the administration of the southern half of Africa. Lest we should be petty-minded and regret this, let us turn our eyes to the recently explored regions of Northern Rhodesia, portions of Nyasaland and Katanga (greatly denuded of indigenous populations by various causes) which now invite settlement, almost by the million, on the part of adventurous white peoples.

The volumes reviewed deal mainly with the history of this interesting Basuto people. They are well illustrated by good photographs, and the numerous pictures of the Basuto types show clearly the three negro elements, imperfectly fused, from which this section of the Bechuana peoples has been built up. There is that of the Bushman (who immediately preceded the Basuto as the indigenous occupant), of the ugly flat-nosed type of Forest Negro or Pigmy (which reappears elsewhere in South Africa), and finally the typical Bantu strain from East Central Africa which imparts to many of the Basuto faces refinement of outline and considerable brain capacity. The scenery of Basutoland (the reviewer writes from actual experience) is amongst the grandest of the world's landscapes, and Sir Godfrey Lagden has taken care to emphasise this by "Wort und Bild." The second volume closes with serviceable notes on the Suto dialect, and appendices of great usefulness to the student of Africa. The book is, however, of very great general interest.

H. H. Johnston.

THE OCEANOGRAPHICAL MUSEUM AT MONACO.

As stated in last week's Nature, the inauguration of the Oceanographical Museum at Monaco took place on March 28, in the presence of representatives of the Governments and navies of France, Germany, Italy, Spain, and Portugal, and a great gathering of men of science of all nations, who were invited by the Prince of Monaco, and entertained as his guests in his ancient palace at Monaco and in various hotels in Monte Carlo. The inaugural *fêtes* lasted for four

[1] Note Sir Godfrey's remarks on this, p. 645, vol. ii.

days; they were planned on a scale of magnificence rarely attempted, and drew upon the resources of art in a manner which we believe has never been paralleled. It would almost appear as if the design were to show that science, no less than pleasure, was a fitting theme for the exercise of art as exemplified in painting, poetry, and music; and that, in any case, the dedication of a great international scientific institution, provided by the princely munificence of an individual, was no everyday matter, to be passed by unnoticed save by the specialists immediately concerned.

The inauguration was an arresting function, which could not fail to impress the most regardless pleasure-seeker in the gayest haunt of the Côte d'Azur with the thought that science, even in, perhaps, its least known department, was a thing of high importance. To us the fact that "someone had blundered" and no admiral of the British Fleet was there to join the high German, French, and Italian officers in offering a tribute to the scientific study of the sea was a cause of humiliation. It is little short of a disgrace that the country in which modern oceanography was created, and the navy the *Challenger* of which revealed the wonders of the ocean as a whole, were brought to the attention of the gathering only by the Prince's generous recognition in his inaugural address of British preeminence in oceanographical research, and in the name of the ship engraved on the façade of the new building. We know, of course, that the breach of international good manners was due to no intention on the part of the King or of the Prime Minister to inflict a slight upon a noble enterprise, but the effect was none the less deplorable, and on behalf of the British scientific public we desire to give expression to this feeling in the most emphatic way. The official representation of the Royal Society, the Royal Society of Edinburgh, the Royal Geographical Society, and the *Challenger* Society showed at least the good will and appreciation of British men of science.

It seems more appropriate to occupy this article with a short description of the museum itself than with details of the formal speeches at the ceremonial inauguration, the performance at the opera, the pageant in the harbour symbolising the landing of Hercules, mythical founder of Monaco, in a blaze of fireworks, and the concluding reception by the Prince in the Palace. One evening was devoted to a series of lantern demonstrations, by Lieutenant Bourrée, which proved of extraordinary interest on account of the kinematograph representation of the routine of work on the *Princesse Alice* in handling the various oceanographical instruments and appliances at sea.

The Prince of Monaco has devoted an increasing amount of time to deep-sea investigation since he commenced his observations on the Gulf Stream in the sailing-yacht *Hirondelle* in 1885, and, as a result of his work in that vessel, in the auxiliary steam-yacht *Princesse Alice,* and in his present splendid vessel *Princesse Alice II.,* he had accumulated, by 1898, so large a collection of natural-history specimens that he resolved to build a museum in which to house them. On April 25, 1899, the foundation-stone was laid on the southern face of the cliff which bounds the peninsula of Monaco, and the great building designed by M. Delefortrie has now been completed and equipped, and was formally inaugurated on March 28 this year. The first object has been greatly enlarged, and the Oceanographical Museum as it is established to-day contains more than the nucleus of a collection gathered from all investigators of all the oceans illustrative of the whole science of oceanography. On the face of the cliff the foundations of the museum are almost at the level of the sea. Two storeys are built facing the sea, with the rock as their rear wall, and the third storey is on the level of the rock forming the ground-floor of the main frontage, which faces north. The material is the extremely fine-grained white limestone of the La Turbie quarries, on the mountains behind Monaco.

The ground plan of the principal floor includes a central hall twenty metres square, with a wing on each side forty metres long by fifteen wide, the whole frontage being a hundred metres. The decoration of the front of the building includes representations in relief of deep-sea invertebrates and fish, and the whole is crowned by the Prince's arms and a gigantic albatross and sea-eagle. The names of the *Challenger, Talisman, Valdivia, Hirondelle, Princesse Alice,* and other ships which have become famous in the annals of oceanography are boldly carved along the front. Two great groups of symbolic statuary flanking the immense window of the landing on the upper floor represent Truth unveiling the forces of the world to science, and Progress coming to the rescue of humanity. The roof of the central part of the building, eighty-seven metres above the sea, forms a meteorological observatory, and the main roof, five metres lower, forms an immense terrace, measuring a hundred metres by fifteen metres. The entrance-hall, floored with mosaics representing the *Princesse Alice* at sea surrounded by trophies of deep-sea fish, contains the two great stone staircases leading to the upper floor, and unobtrusive doors leading to the stairs by which the director's room, library, laboratories, workshops, and aquarium on the lower floors are reached. It opens into a large square hall, lighted at night by an immense pendant representing a medusa, the lights in which are so disposed as to bring out the anatomy with extraordinary distinctness. Four smaller lights are encased in models of radiolarians very exactly reproduced.

A marble statue of the Prince in yachting costume, leaning on the rail of his yacht, occupies the centre of the hall; this remarkably fine portrait, executed by M. D. Puech, was presented by a number of the sovereigns of Europe and other admirers of the Prince. Great doors to right and left open into the two wings of the building, each forming a lofty hall, lighted by windows along each side, which may be shaded or darkened as required. The western hall is at present fitted as a meeting-room for functions, and here the ceremony of inauguration and the banquet took place. The platform at the west end is surmounted by an immense painting showing the slaty-blue ocean heaved into a long swell, with the white form of the *Princesse Alice* in the background. Electric lights in clusters, representing seaweeds and marine animals, hang from the roof, and the ceiling is frescoed with views of the sea and ships.

The eastern hall is occupied by a collection of oceanographical apparatus and specimens of marine zoology, arranged in a provisional way. The collection includes several whale skeletons, Arctic and Antarctic seals, models of fish, and a vast number of specimens in preservatives. The labels are written in French, English, and German, and give sufficient details of the exhibits to enable a visitor to appreciate the remarkable character of many of the specimens.

On the upper floor, the central hall contains models of the *Princesse Alice I.* and the *Princesse Alice II.,* showing the arrangements for sounding and for working the zoological apparatus. There is a whale-boat exactly as used by the modern whaler, with the gun throwing the explosive harpoon at the bow, and the full equipment of harpoons, lines, and lances. The eastern hall on this floor will ultimately be devoted

to physical oceanography and to deep-sea apparatus. Here there is a great collection of dredges, tow-nets, showing the various devices for opening and closing at a given depth, the deep-sea traps with which the Prince has revolutionised the method of obtaining animals from the greatest depths, and many other appliances, either as used or in the form of models. At present a part of the room is occupied by a collection of specimens illustrating marine industries, such as fishing, sponge-gathering, collecting pearls, as well as the use of pearl-shell, coral, tortoise-shell, and similar products. The western hall is not yet arranged, but serves at present for classifying the various collections of mollusca, bottom-samples, &c., which are being dealt with.

The purpose of the museum is to have all the principal collections in duplicate, one set for exhibition, the other for purposes of study. The aquariums have already been utilised for the purpose of physiological and biological researches, and the little steam-vessel *Eider* is available for students to familiarise themselves with the methods of practical oceanography. This little steamer, of twenty tons displacement and sixty horse-power, is fitted for working to a depth of 2000 metres, and is being used for the detailed study of the portion of the Mediterranean in the immediate vicinity of the museum.

The Oceanographical Museum, under the direction of Dr. Richard, to whose admirable description of the building and the collections we are much indebted, is only one part of the Oceanographical Institute which the enlightened munificence of the Prince of Monaco has called into existence. With the object of arousing interest in scientific marine studies in France, the Prince started a series of lectures at the Sorbonne in 1903, and in 1906 he gave perpetuity to these courses of lectures by purchasing land which was much wanted for the extension of the university buildings and presenting it to the French nation, together with a building specially devoted to university instruction in oceanography. This building is now nearing completion, and will probably be opened in the present year, or at latest in 1911. Needless to say, the university and the French Government accepted the gift with lively gratitude. Three professorships have been created in connection with it, M. A. Berget having the chair of physical oceanography, M. L. Joubin that of biological oceanography, and Dr. P. Portier that of the physiology of marine life. The administrative council, under the presidency of the Prince, includes the names of several highly distinguished Frenchmen, but the committee for perfecting the institute is international, and includes representative oceanographers of all countries, Great Britain being represented by Sir John Murray, Dr. W. S. Bruce, and Mr. J. Y. Buchanan.

During the course of the Monaco gathering four important international committees met, each with the Prince as chairman, and, considering how his time was filled with State ceremonies and hospitality, it is only extraordinary enthusiasm, as well as most unusual physical strength, that enabled him to preside hour after hour, with unfailing courtesy and constant tact, over proceedings conducted in three languages. The committees were those for perfecting the Oceanographical Institute; for research in the Mediterranean, in which we understand that the Italian Government will take an active part; for research in the Atlantic, where international cooperation is hoped for, to be organised at a future meeting to be convened by the Oceanographical Institute in Paris; and, finally, for the preparation of a new edition of the Prince's bathymetrical chart of the oceans. It was decided in the new edition of this chart to suppress the indication of the nature of the bottom, which is often fallacious, to add contour lines and certain physical features on the land, and to revise the terminology.

By his researches the Prince of Monaco has won for himself a place in the foremost rank of men of science, and by enshrining the results in the monumental buildings at Monaco and Paris he has invested his labours with permanent value for all time. His modesty and earnestness greatly impressed all those who took part in the proceedings here described, and, if a proof of this is demanded, it is enough to say that no one in authority mentioned the cost of the works, which is usually a prominent feature in the description of any benefaction.

THE RECENT GROWTH OF POPULATION IN WESTERN EUROPE.

IN his inaugural address as president of the Royal Statistical Society, delivered in November last and published in the Journal of the Society for December, Sir J. A. Baines deals in detail with the growth of the population of western Europe during the thirty years 1870–1900. The review covers the sixteen countries of western Europe properly so-called, excluding Russia, the countries of south-eastern Europe, and the "half-way" States of Hungary, Galicia, and Poland. In 1870 the population of western Europe so defined amounted in round numbers to 192 millions, a total which had increased by 1900 to 239 millions—an increment of nearly 25 per cent. But, as shown by the table below, the rate of increase was very different in different countries.

Country	Total percentage increase of population 1870–1900	Average annual rates of increase per thousand, 1870–1900		
		Natural	Census	Leakage
Sweden	23·2	11·7	7·0	4·7
Norway	28·9	13·9	8·5	5·4
Finland	53·3	13·9	13·2	0·7
Denmark ...	36·1	12·9	10·3	2·6
Holland	43·2	13·1	12·0	1·1
Belgium	33·3	9·8	9·6	0·2
Germany ...	38·1	12·5	10·8	1·7
West Austria ...	24·4	7·8	7·7	0·1
Switzerland ...	24·2	7·9	7·2	0·7
England ...	43·2	13·0	12·0	1·0
Scotland ...	33·1	12·8	9·6	3·2
Italy	21·9	9·4	6·6	2·8
Spain	12·8	4·9	4·0	0·9
Portugal ...	24·2	9·9	7·3	2·6
France	6·0	1·4	1·9	+0·5
Ireland	−17·6	6·1	−6·5	12·6
Total	24·6	8·7	7·4	1·3

France and Ireland are both very exceptional; the population of Ireland actually decreased by nearly 18 per cent., while that of France increased by 6 per cent. only. In the Scandinavian countries, the increase ranged from 23 per cent. in Sweden to 36 per cent. in Denmark and 53 per cent. in Finland; in the central group from 24 per cent. in western Austria and Switzerland to 43 per cent. in England and Holland. In all countries except France, the natural rate of increase, by excess of births over deaths, has been greater than the actual rate of increase, the average annual rate of increase by excess of births over deaths amounting (as shown by the second column of the above table) to 8·7 per thousand of the population, while the census only shows an average annual increase of 7·4 per thousand. The loss, or "leakage," has been greatest in Ireland, and next greatest in Norway and Sweden; in all countries save Italy the rate of loss was greater in the decade 1880–90 than in either the earlier or the later decade—in fact

nearly three times as great—but the continuous increase in emigration from Italy has placed it of recent years at the head of the emigrating countries (Ireland excluded).

In all the countries considered, both birth- and death-rates have fallen, and in the majority, especially those countries (as Holland, Germany, and Austria) in which the death-rate at the commencement of the period was high, the fall in the death-rate has exceeded the fall in the birth-rate, as shown by the table below; the natural rate of increase was therefore greater at the end than at the beginning of the period, in spite of the fall in the birth-rate. England is one of the exceptional countries, for the death-rate, even at the commencement of the period, was moderate, and the fall in the birth-rate has rather more than kept pace with the fall in mortality.

Country	Mean annual death-rate per 1000[1] 1871–1900	Mean annual birth-rate per 1000[1] 1871–1900	Decline per cent. in rates between 1871 and 1900	
			Deaths	Births
Sweden	17·2	28·9	10·4	11·2
Norway	16·8	30·7	4·1	2·3
Finland	21·0	34·7	11·2	13·0
Denmark ...	18·3	31·2	10·8	3·9
Holland... ...	21·2	34·3	24·3	11·4
Belgium... ...	20·8	30·5	15·0	10·2
Germany ...	24·8	37·3	18·3	7·7
West Austria...	27·6	35·4	13·3	6·5
Switzerland ...	21·1	29·0	19·1	8·7
England ...	19·6	32·6	14·9	15·5
Scotland ...	19·8	32·6	13·4	12·3
Italy	27·1	36·5	19·0	5·4
Spain	30·6	35·5	3·6	2·2
Portugal... ...	*22·1*	*32·1*	—	—
France	22·4	23·8	9·3	12·6
Ireland	18·2	24·3	1·1	13·2
Total	23·8	32·5	13·7	6·6

[1] Figures in italics are partly estimated.

The factors contributing to the fall in the birth-rate, which has recently attracted so much attention, are analysed in detail by Sir Athelstane Baines. For the most part it is clearly due to a fall in the fecundity of married women of reproductive age. The proportion of women of reproductive age to the population has in many countries (as in the United Kingdom) slightly increased, in other cases remained almost steady or fallen very little. The proportion of such women who are married, as shown by the table below,

Country	Number married per 1000 women aged 15–45[1]		Legitimate births per 1000 married women, 15–45[1]	
	1870	1900	1870–80	1890–1900
Sweden	420	411	278	268
Norway... ...	436	418	302	301
Finland	*502*	471	*285*	292
Denmark ...	450	463	268	259
Holland... ...	440	446	345	321
Belgium... ...	409	471	338	252
Germany ...	471	504	319	285
West Austria...	*448*	473	295	271
Switzerland ..	419	442	288	266
England ...	496	469	292	235
Scotland ...	435	420	311	271
Italy	520	539	286	269
Spain	*562*	557	*262*	259
Portugal ...	420	452	—	259
France	531	552	195	159
Ireland	401	325	306	288
Total	490	500	276	249

[1] Figures in italics are partly estimated.

has fallen in all the Scandinavian countries save Denmark, but has increased in all the countries of the central group, except England and Scotland. The births per thousand married women of fertile ages, on the other hand, have fallen in every country, with the sole exception of Finland (and perhaps one should add Norway), and most markedly in the central European group.

"The thirty years included in my survey," Sir Athelstane Baines concludes, "have been generally characterised by a moderate rate of growth of population, interrupted until towards the end of that period by considerable emigration, since reduced, except in one or two cases. People marry a little more than they did a generation ago, and, in most of the countries reviewed, they marry earlier; but the growth in the relative number of the married has been accompanied by a material decline in their output of children. Illegitimate unions, also, whether less frequent than before or not, at least contribute less to the tale of births. The community is therefore almost everywhere becoming an older one, with a gradually decreasing basis for the coming generation. Thanks to a general improvement in hygienic conditions, fewer succumb to disease, especially in early life, and the mortality having decreased more rapidly than the fertility of the population, the excess of births over deaths is relatively not below, but, on the whole, indeed, a little above that which prevailed at the beginning of the period."

PROF. HANS LANDOLT.

ON March 15, Geheimrat Prof. Landolt, the Nestor of physical chemists, passed to his rest, full of years and of honours. How few are left now of that ardent band who, in the early 'fifties, came under Bunsen's inspiration in romantic Heidelberg!

In a brief notice it is impossible to give an adequate picture either of the man or of his deeds. One is glad to think, however, that his devotion to science will be recognised in the memorial lectures by which the various societies strive to do honour to the memory of distinguished investigators.

Hans Heinrich Landolt was born in Zürich in 1831, and began the study of chemistry in the university of his native town. His *Wanderjahre* were spent in Breslau, where he graduated, in Berlin, where he studied under Rose and Mitscherlich, and, finally, in Heidelberg. His progress in the academic career was rapid. He became a Privatdozent in Breslau (1856), an extraordinarius professor in Bonn (1858), and an ordinarius professor in Bonn (1867). He then proceeded to the Technische Hochschule in Aachen. In 1880 we find him in Berlin, where he occupied the chair of chemistry in the Landwirtschaftliche Hochschule until, in 1891, he succeeded Rammelsberg as director of the second chemical institute of the university. When old age came upon him, his enthusiasm did not wane; he was active to the last.

Landolt's researches were by no means confined to one branch. In organic chemistry he studied, for example, compounds of arsenic and antimony, the action of potassium amide on various carbon compounds, and the chemical changes in the flame of coal gas. In inorganic chemistry he dealt with subjects such as phosphine, solid carbon dioxide, ammonium amalgam, thiosulphurous acid in aqueous solution, the interaction of bromine and nitric oxide. It is, however, on his pioneering experiments on molecular refraction and optical activity that his fame as an investigator will last for all time. With the exception of the contributions of Biot, very little of importance had been done on the measurement of the specific rotations of optically active substances until the field was taken up by Landolt in a series of papers which are models of exactitude. As a consequence of the experience he gained, workers in stereochemistry are indebted to him for numerous improvements in the technique of polarimetric observation.

He was engaged during the last twenty years of his life on the fundamental problem as to whether a change of mass during a chemical action can be effected by the ether possibly taking part, as it might be conceived to do by the appearance or disappearance of electrons or by the disintegration of atoms. The final result of these experiments, which demanded on the part of the manipulator the exercise of extreme patience, and involved the most exact measurement, was a confirmation of the law of the conservation of mass.

It may be added that Landolt's "Optisches Drehungsvermögen organischer Substanzen und dessen praktische Anwendungen" and his "Physikalisch-chemische Tabellen" (with Börnstein) are classical works of reference.

In a land where men of science are held in honour, it was natural that Landolt's services as a teacher and investigator should be appreciated to the full. Although he himself was the most unassuming of men, and although his work was not of the kind to bring him into the glamour of the footlights, it fell to his lot to receive an unusual number of high distinctions. He was held in esteem and affection by all who had the privilege of his acquaintance.

ALEX. MCKENZIE.

PROF. R. ABEGG.

PROF. RICHARD ABEGG, whose untimely death, in his forty-second year, was referred to in these columns on April 7, was one of the most distinguished representatives of the second generation of physical chemists. It was at the end of a ballooning expedition on April 3 that, whilst attempting to land, the balloon in which Prof. Abegg had journeyed from Breslau to Köslin caught in some bushes and tilted, with the result that he was thrown out and sustained a fracture of the skull, from which he expired in the early morning of April 4.

Abegg studied chemistry at Kiel, Tübingen, and Berlin, and devoted himself at first to organic chemistry. He took his degree, as a student of A. W. von Hofmann, in 1891, with a dissertation on amidochrysene, but the far-reaching results then recently achieved in the field of physical chemistry attracted him, and led him into post-graduate work in the laboratories of Ostwald, Arrhenius, and Nernst.

As assistant to Nernst in Göttingen from 1894 to 1899, Abegg devoted himself to most of the problems of physical chemistry. The action of kathode rays on various salts, the silver germ theory of the latent image, measurements of the depression of freezing points and the osmotic pressure of concentrated solutions, and electrochemical problems in turn claimed his attention, but his theory of electro-affinity, which was formulated along with Bodländer, marks his greatest achievement at this stage of his career. In 1899 Abegg went to Breslau University, where he was soon made an extraordinary professor. Here he continued his work, but a good deal of his time was absorbed by editorial duties. The theory of electro-affinity led to much work on complex ions, which was carried out in conjunction with pupils from all parts of the world, including England, Russia, Japan, America, and Australia, and this work in turn led to the formulation of his theory of valency.

Abegg acted as editor of the *Zeitschrift für Electrochemie*, and at the time of his death had edited about half of a "Handbuch der anorganischen Chemie." It is to be hoped that the work in connection with this Handbuch is so far advanced as to ensure its completion. In connection with analytical chemistry, along with Prof. Herz, Abegg published his "Chemisches Praktikum," which marks an initial step in the application of the ionic theory to the early stages of qualitative analysis, a step which had been indicated by Ostwald in his "Wissenschaftliche Grundlagen der analytischen Chemie."

At the London International Congress of Applied Chemistry, Abegg was appointed on a committee to consider the annual publication of tables of physico-chemical constants, and he attended a meeting of this committee held in Paris last October. Last October Abegg was appointed director of the Physico-Chemical Institute at the new Technische Hochschule at Breslau, which is to be opened next October in the presence of the Emperor.

Finally, a word as to Abegg's genial personality. He made his students feel like colleagues, and was always available with suggestive advice. If we place Abegg in the second generation of physical chemists, he has done his duty by the third generation, and his death will be mourned as a personal loss in all parts of the world.

SIR WILLIAM BOUSFIELD.

ALL friends of education will deeply deplore the loss of Sir William Bousfield, who died on April 7, in his sixty-eighth year. Although he had received the ordinary Oxford education, Sir William Bousfield's wide culture and sound judgment enabled him to see the growing importance of practical and scientific education, and to form correct conclusions on the advice, which he eagerly sought and acted upon, of scientific men. Elected to the London School Board, of which he was a member for six years, in 1882, he took the deepest interest in all problems connected with the improvement of elementary education, and, during his membership, he was chairman of the special committee which was appointed to consider the question of manual training. That committee took evidence from a number of experts, and it was mainly owing to its recommendations that the City and Guilds of London Institute and the Drapers' Company subsequently provided funds for a great educational experiment in the provision of manual instruction in a certain number of schools under the direction of the Board, which resulted, not only in the general adoption of handicraft instruction for boys, but also of domestic teaching in all girls' schools. The success of this experiment was largely due to the efforts of Sir William Bousfield, who, when he ceased to be a member of the School Board, became vice-chairman of a joint committee, under whose direction these important experiments were successfully carried out.

Associated with the Worshipful Company of Clothworkers by family tradition, he was appointed, in the year 1887, a representative of that company on the council of the City and Guilds of London Institute. Although the Institute was exclusively concerned with the development of scientific and technical instruction, Sir William Bousfield's advice proved of the greatest possible service to the several committees of the Institute charged with the different branches of its work. It is, however, in connection with its technology committee—of which he was, for many years, first vice-chairman and subsequently chairman—that his loss will be most felt. In the solution of the many difficult problems with which the department of technology has had to deal, Sir William was able to render great assistance, and, of recent years, as chairman of the board of examinations of that department, which was charged with the preparation of schemes of instruction in every branch of technology, his help

was greatly appreciated. The continuous development of the work of that department, not only in the United Kingdom, but also in the colonies, was largely due to his clear judgment and full appreciation of the value to artisans and others of the technical instruction which was thus encouraged.

It is, however, in connection with efforts for the improvement of girls' education generally that Sir William's name will be best remembered. To the work of the Girls' Public Day School Trust, over which he presided, and which owed its success largely to his efforts, Sir William devoted himself without sufficient thought of the strain upon his health and energies. All who have had the privilege of acting with him recognise the extent to which his courtesy of manner and wise counsel enabled them to overcome difficulties arising frequently from conflicting interests. Of his services to the cause of charity organisation and social reform this is not the place to speak, but there can be no doubt that all those who are now occupied in the promotion and improvement of sound education in this country are the poorer for his loss.

NOTES.

We announce, with deep regret, the death of Sir Robert Giffen, K.C.B., F.R.S., on April 12, at seventy-three years of age.

Prof. J. H. Poynting, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

The council of the Linnean Society at its last meeting decided to award the Linnean gold medal to Prof. Georg Ossian Sars, professor of zoology in the University of Christiania, in recognition of his eminent services to zoological science. Prof. Sars has been a foreign member of the Linnean Society since 1899.

Mr. C. Bird, headmaster of the Rochester Mathematical School, and the author of text-books on geography and geology, died on April 11 at sixty-seven years of age. He was three times president of the Rochester Naturalists' Club, and was a Fellow of the Geological Society.

A joint meeting of the American Society of Mechanical Engineers with the Institution of Mechanical Engineers will be held this summer in Birmingham and London. The meeting will open at Birmingham with a reception by the Lord Mayor of Birmingham and the members of the local committee on Tuesday, July 26. Following the meetings at Birmingham on July 26–28, the members of the American Society of Mechanical Engineers will be entertained in London. A conversazione will be held at the institution on the evening of July 28, and the following day will be devoted to the reading and discussion of papers in the morning and a dinner in the evening.

Columbia University, New York, is about to lose, by his resignation, the services of Dr. Charles F. Chandler, who has held a chair of chemistry in that institution since 1864. The completion of his academic career will be signalised by a banquet to which he will be entertained in the Waldorf-Astoria Hotel on April 30 by a number of the leading American chemists. On that occasion Dr. Chandler will be presented with a bronze bust of himself, and there will be created, as a permanent memorial, a Chandler testimonial fund in aid of the library of the Chemists' Club.

A number of changes in the organisation of the mir inspectorate and mines inspection districts have just be approved by the Home Secretary, who has followed t recommendations of the Royal Commission on Mines. connection with these changes, the following appointmer have been made:—Dr. W. N. Atkinson, divisior inspector for the new South Wales district; Mr. W. Pickering, divisional inspector for the new Yorkshire a North Midland district; Mr. H. Johnstone, divisior inspector for the new Midland and southern district; a Mr. W. Walker, divisional inspector for the new Scotla district.

A general discussion on the constitution of water w be held on Tuesday, April 26, at the Faraday Societ Prof. James Walker, F.R.S., will preside. The discussi will be opened by Prof. Walden, of Riga, followed the reading of short papers by Prof. P. Guye, Mr. W. Bousfield, K.C., and Dr. T. M. Lowry, and of commun cations sent by Prof. Nernst and Mr. W. Sutherland, the University of Melbourne. In connection with the di cussion, and particularly in honour of Prof. Walden, dinner of the society will be held on the following evenin Wednesday, April 27, at the Trocadero Restaurar London, W. The president of the society, Mr. Jam Swinburne, F.R.S., will preside.

The progress of the recent eruption of Etna is shov in the following summary of Reuter telegrams fro Catania:—*April* 7.—The eruption of Mount Etna co tinues. The stream of lava from Cisterna Regina advancing slowly, while the stream from Monte Nocil has considerably increased. It is now 300 metres in widt *April* 8.—One lava stream is increasing in speed, and h entered the Fusara district, travelling at about nine yar an hour. *April* 11.—Several of the Etna craters contin in active eruption. The flow of lava from the Fusa crater has ceased, but the streams from Monte Sona a in the Bottari plain are still advancing.

In connection with the aviation week to be held Verona in the first fortnight of May, it is proposed organise a first International Congress on Aërial Loc motion. On the scientific side the movement has receiv the support of Profs. Angelo Battelli (Pisa), Giovan Celoria (Brera Observatory), Giuseppe Colombo (Mila Count Almerigo di Schio, Dr. Enrico Forlanini, Pr Luigi Palazzo, Prof. Righi (Bologna), Prof. Vito Volter (Rome). Hitherto there have been few opportunities interchange of ideas between those interested in t theoretical and practical aspects of aërial navigation, a the proposed congress should afford a valuable opportun for effecting a closer rapprochement between workers w are studying the problem from widely different points view.

The Sheffield meeting of the British Association w open on the evening of Wednesday, August 31, wh Prof. T. G. Bonney, F.R.S., will assume the preside in succession to Sir J. J. Thomson, F.R.S., and w deliver an address. On Friday, September 2, the fi evening discourse will be delivered by Prof. W. Stirli on "Types of Animal Movement." On Monday, S tember 5, the second evening discourse will be delive by Mr. D. G. Hogarth, on "New Discoveries about Hittites." The concluding meeting will be held Wednesday, September 7. A reception will be given at Town Hall by the Lord Mayor (the Earl Fitzwillia D.S.O.) on Thursday, September 1, and a reception w be given at the University on Tuesday, September 6.

number of garden-parties will be arranged, full particulars of which will be announced later.

The Argentine Scientific Society is organising an International American Scientific Congress, to be held in the city of Buenos Aires on July 10–25. This congress will form one of the items of the programme arranged to commemorate the centenary of the revolution of May, 1810, which brought about the independence of the Argentine nation, as well as that of other nations of South America. Dr. J. F. Alcorta, President of the Argentine Republic, is the president of the congress, and Prof. N. B. Moreno and Mr. E. M. del Pont are the general secretaries. The work of the congress will be done in eleven sections, each having a number of subsections. The sections and the presidents appointed are as follows:—engineering, Mr. L. A. Huergo; physics and mathematics, Dr. M. R. Candioti; chemistry, Dr. A. Quiroga; geology; anthropology, Dr. F. Ameghino; biology, Dr. A. Gallardo; geography and history, Dr. F. P. Moreno; economics and statistics, Dr. E. S. Zeballos; military science, Brigadier-General P. Riccheri; naval science, Rear-Admiral M. J. G. Mansilla; psychology, Dr. H. G. Piñero. All communications should be addressed, according to circumstances, to the president of the executive committee, Mr. L. A. Huergo, or to the president of the committee of propaganda, Mr. S. E. Barabino, care of the Argentine Scientific Society, 269 Calle Cevallos, Buenos Aires.

A "Photographic Arts and Crafts Exhibition" is open for this week only at the Royal Horticultural Hall, Vincent Square, Westminster. It is an excellent and representative show of modern photographic apparatus and materials, and includes a pictorial section, in which may be seen some of the finest portrait work, and examples of the applications of photography to various technical purposes, such as criminology, metallography, photomicrography in colours, &c. Demonstrations, lectures, and cinematograph shows are given from time to time. With regard to cameras, the chief fact that strikes one is the total absence of the large cameras that were familiar some years ago, often specially made for exhibition, and instead of them there are innumerable small cameras, some excessively small, and others of more moderate size, but all designed to give the utmost portability with efficiency. Messrs. Marion and Co. show one that takes plates $1\frac{3}{4}$ inches by $2\frac{3}{8}$ inches, and folds into a rectangular block that weighs only 6 ounces, and is about half an inch thick, including the lens and shutter. Messrs. Adams and Co., Messrs. Houghtons, Messrs. A. E. Staley and Co., and other firms show cameras nearly, if not quite, as compact, and some of these are of a quality of workmanship that leaves nothing to be desired, and when provided with a first-class lens give pictures that will permit of considerable enlargement, so that a really efficient camera may now be the constant companion, in fact as well as in name, of naturalists and travellers, without the feeling that it is something extra to be carried. The present tendency to develop in tanks for predetermined times is obvious in the many models of apparatus for this purpose. The Standa Company has a new pattern in which the rack that carries the plates is hinged so that it will open out, and, if suspended by one end, allows free access of air to the surfaces of all the plates, a convenient method of drying them. Colour photography is represented by Messrs. Sanger Shepherd and Co., Messrs. Lumière, and Messrs. Wratten and Wainwright. Telephoto. lenses are shown by Messrs. Dallmeyer, Messrs. Staley and Co., and others. There are altogether about seventy firms exhibiting, excluding the pictorial section. A lecture on "Spirit Photography" is given three times daily, illustrated by some alleged "real spirit" photographs, as well as by examples of what is possible by well-known methods.

In *L'Anthropologie* (January-February) Prince Georges Cantacuzene describes a collection of eleven skulls from a primitive cemetery at Corneto, near Civita-Vecchia. Of these he gives a detailed series of measurements, and the result of his investigation is to confirm the view that the old Roman race was composed of several divergent types.

In the *National Geographic Magazine* for February Mr. Byron Cummings describes the great natural bridges in Utah. They are the result of a disturbance of the vast strata of red and yellow sandstone underlying that region, which left natural obstacles through which the rivers have worn their way. One of them is the Edwin Bridge, a graceful structure with a span of 194 feet and an elevation of 108 feet. Finer than this is the Augusta Bridge, combining massiveness with graceful proportions. It is 222 feet high and 261 feet between the abutments. Still greater, if not so well proportioned, is that which the Indians know as Nonnezoshi, or "Stone Arch," the greatest natural arch as yet found, measuring 308 feet in height and 275 feet between the abutments. In some places the process by which these natural wonders were formed may still be seen in action.

Major Stanton, late Governor of Khartum, in a lecture recently delivered before the Colonial Institute, quoted in *Travel and Exploration* for April, notices a curious fact about the jerboa, or kangaroo rat. "It is found in considerable numbers in places miles and miles away from any water or even dew, and I was at a loss to understand how these little animals could exist through the ten months of drought. It appears, however, that after the scanty rains a small wild melon, of bitter taste but full of juice, flourishes in the desert. The jerboa, as soon as the melon is ripe, bites off the stem and proceeds to dig away the sand under the melon, so that it gradually sinks below the level of the ground. The constant wind soon covers it over with 6 to 8 inches of sand, which protects it from the scorching sun and from drying up. When all other moisture has evaporated, the jerboa goes to his larder of melons, and drinks the juice of these till the rains come on again. One jerboa will bury as many as forty of these little melons to last him through the dry season."

L'Anthropologie (Tome xx., No. 5) contains an interesting article by Dr. R. Verneau on three skulls discovered by M. Mansuy in the cave at Pho-Binh-Gia, in the oldest beds yet explored in Indo-China. This cave is situated 400 m. west of the village of the same name and 75 kil. north-west of Lang-Son (Tonkin). All three skulls are of the same ethnic type, and apparently belonged to a race of more than medium height. The most complete is that of a male, of which the mandible has also been obtained. A detailed description of the three skulls is given. The complete male skull is dolichocephalic (index 73·47), slightly phænozygous, with a rather narrow but well-curved forehead, somewhat prominent parietal protuberances, and the supraciliary arches are prominent only in the region of the glabella. The chief characteristic of the head is its disharmony, in which respect the old Indo-Chinese race approaches the Cro-Magnon race of the Reindeer period, the Grimaldi type of the mid-Quaternary age, and Lagoa Santa man, the most ancient type yet known in South America. The skulls of Pho-Binh-Gia are certainly not

Mongol. They seem rather to be representatives of the primitive Indonesian type, of which the Miao-tse and Khâs, as well as various peoples in the East Indian Archipelago, are descendants. The skulls appear to belong to the white rather than the yellow branch of the human race, which fact supports M. de Quatrefages's theory (which has been accepted by other students) of a white element having lived once in the continental regions of the Far East. The implements associated with these remains are of a Neolithic type; ornaments and pottery are rare. The absence of bones of large edible animals in the archæological layer leads to the conclusion that the ancient troglodytes of Pho-Binh-Gia were mainly vegetable feeders, but they also fed on fresh-water molluscs. It is proposed to make a fresh investigation of this important cave.

The whole of part vii. of vol. cxviii., Abt. iii., of the *Sitzungsberichte* of the Royal Vienna Academy of Sciences is devoted to a relatively long article by Mr. O. Straeker on the plica longitudinalis of the duodenum, with its associated papilla, in man and the lower mammals, these remarkable structures being discussed in detail from the morphological, histological, and physiological standpoints in a number of species.

A special exhibit has been made in the hall of the Natural History Museum of the mounted skin and skeleton of the specimen of the monkey-eating eagle (*Pithecophaga jefferyi*) recently living in the Zoological Society's Gardens, and the only example of its kind hitherto exhibited alive in England, and probably in Europe. This splendid eagle, it will be remembered, was discovered by the late Mr. J. Whitehead, and described, as a new genus and species, by Mr. Ogilvie-Grant in the *Ibis* for 1897, its nearest relative being apparently the South American harpy eagle (*Thrysaëtus harpyia*). Great credit is due to Mr. Rowland Ward for having made a complete mounted skin and skeleton from a single bird.

Considerable interest attaches to a letter in the *Field* of April 2 from Mr. C. W. Stockley on rhinoceroses living for long periods in Somaliland without water. They inhabit certain parts of the Bur Dab, where, during the dry season, there appear to be no pools over a considerable area, the two nearest known drinking-places being thirty-three and forty-five miles distant. To these pools it is believed the rhinoceroses make only very occasional journeys. Such moisture as they require is obtained by eating the leaves of an aloe locally known as *dur*. Beisa oryx, on the other hand, maintain existence in the thirstland by eating a small kind of gourd, called by the Somalis *unun*; but kudu, which likewise go without drinking for long periods in this country, browse on *dur*.

We have been favoured with a copy of an excellent little illustrated guide to elk and ptarmigan shooting in Norway, by Mr. Erling Hiorth, published, in English, at Christiania. Brief accounts are given of the haunts and habits of the two species, together with full information as to sporting localities, hotel-accommodation, tariffs, game-regulations, suitable clothing, &c. The pairing-season of elk in Norway commences about September 20, and the stags shed their antlers the following February, and begin to grow the new ones in May, which are clear of the velvet in August or September. The antlers begin to degenerate after the twelfth year. Highland elk are stated to differ from those of the plains by the slight development of palmation in the antlers. The calves, either one or two at a birth, are born in May.

We have received vol. xii. of the third series of the *Anales del Museo Nacional de Buenos Aires*, the contents of which include Dr. Ameghino's paper on Diprothomo, already noticed in Nature, as well as several articles by Mr. Juan Bréthes on South American Diptera and Hymenoptera, and a long one by Mr. C. Spegazzini on Argentine Mycetozoa. In two articles from the succeeding volume (xx. of the complete series) Dr. Ameghino describes a young tapir-skull from Tucuman as a new species under the name of *Tapirus spegazzinii*, and likewise adduces evidence considered to prove the existence of a prelacteal dentition in the genus. The Tucuman tapir differs from *T. americanus* in its shorter and wider nasals. The presumed existence of a prelacteal dentition is afforded by the presence of small dental caps overlying some of the teeth of the milk-series.

The alien problem has long since been acute in Great Britain in the case of human bipeds, and it promises ere long to become so as regards their feathered analogues, for the additions to the list of "British" birds are becoming appallingly frequent, the two latest, according to the April number of Witherby's *British Birds*, being the lanceolated warbler (*Locustella lanceolata*), a specimen of which was shot in Lincolnshire on November 18, 1909, and the Corsican woodchat (*Lanius senator badius*), of which an example was killed in Romney Marsh on June 20 of the same year. The former species breeds in Kamchatka, Japan, and Saghalin, and appears never to have been previously recorded from western Europe, so that it has nothing whatever to do with the British fauna. To exclude such stragglers from the British list seems impossible, as there is a gradual transition from these to species which are more regular visitors. At the same time, their inclusion is a great nuisance, as tending to swamp the proper fauna, and a satisfactory way of dealing with the difficulty is urgently required.

The *Bulletin du Jardin Impérial Botanique*, St. Petersburg (vol. x., part i.), contains a list of fungi from the district of Moscow compiled by Mr. J. P. Petroff, and a note on the geotropism of some luffa fruits by Dr. N. Monteverde and Mr. V. Lubimenko. The latter refers to *Luffa acutangula* and other species, which it is stated acquire a positive geotropic tendency at the period when the fruits ripen with the purpose of casting the lid to allow of the escape of the seeds.

Systematic articles in the *Kew Bulletin* (No. 2) are provided by a revision of the genus Myxopyrum, communicated by Mr. A. W. Hill, and a decade of new African determinations. Mr. C. E. Legat presents an account of a trek from Pietersburg in a north-eastern direction across the Zoutpansberg range in the Transvaal, undertaken with the object of studying the trees and shrubs growing in this little explored region. South of the range *Dombeya rotundifolia*, *Sclerocarya caffra*, and *Dichrostachys nutans* were frequently met with; *Copaifera mopane*, *Pterocarpus angolensis*, and *Adansonia digitata* were found to the north. A summary of Thompson's report on the forests of the Gold Coast directs special attention to arguments adduced as to the great influence of forests on physical and climatic conditions.

An article on Chinese Rubi, by Mr. W. J. Bean, published in the *Kew Bulletin* (No. 2), gives particulars of some of the new species collected by Mr. E. H. Wilson. Their beauty lies chiefly in the stem and foliage, although one or two may, under cultivation, yield new fruits of good quality. *Rubus Veitchii*, noted as one of the most attractive, is a bush with purple stems and handsome pinnate leaves. *R. polytrichus* is a dwarf shrub without prickles, but densely clothed with hairs. *R. coreanus* is distinguished by its bluish-white stems, and *R. Parkeri*

is an elegant climber. The opportunity of studying these and other Chinese species is afforded by the establishment of a border in the gardens among the collection of the Rosaceæ near the Pagoda.

A MAGNIFICENT botanical scene in the Lichiang range, situated in the big Yangtse bend in western Yunnan, is briefly described by Mr. G. Forrest in the *Gardener's Chronicle* (March 26). The limestone valley, at an altitude of 9000 feet, is the home of many Primulas, notably *Poissonii*, *denticulata* and *Forrestii*. The lower slopes of the range are covered with two dwarf evergreen species of oak and pines, and the cliffs are clothed with masses of Primula, Cremanthodium, Meconopsis, Gesnera, and other brilliant flowers. The pine belt ranges from 10,000 to 13,000 feet, where it gives place to rhododendron forest and scrub, and that in turn to Alpine pasture. The pine belt yields the finest and rarest plants, *e.g.* many species of Primula, Lilium (including *L. lophophorum*), Cyananthus, Codonopsis, and Androsace. The Alpine pastures also abound in magnificent plants, the most unique being two new densely-hirsute species of Saussurea, found on limestone rubble at a height of 16,500 feet.

REPORTS on various field trials with mangolds, swedes, and seeds hay have recently been issued from the Midland Agricultural and Dairy College. The trials are made on the usual lines, and aim at discovering the best varieties of the particular crops and the most suitable manures for use in the districts concerned.

ABOUT eight years ago sisal was introduced into British East Africa, and found to grow well. The quality of the fibre is satisfactory; its quantity is rather higher in the coast belt than in the highlands, but the cost of production in the latter case is less than in the former by reason of the better climate and cheaper and more regular labour supply. In the *Agricultural Journal of British East Africa* (vol. ii., part iii.) the whole problem is discussed, and although no definite conclusion is reached, there seems a prospect that the industry may be put on a sound basis.

IT is not unusual in some districts to use sawdust as litter for cattle, and as it would then form a constituent of the manure produced, its nitrogen-content is a matter of some interest. Mr. Kinch recently examined a number of samples, and the results published in part v. of the *Agricultural Students' Gazette* are as follows:—

	Nitrogen	Mineral matter		Nitrogen	Mineral matter
Oak...	... 0·155	... 0·20	Spruce	... 0·14	... 0·71
Elm...	... 0·27	... 1·38	Larch	... 0·18	... 0·25
Ash ..	... 0·29	... 0·68	Red pine	... 0·30	... 0·33

These figures refer to the dry matter. In its ordinary state sawdust might be supposed to contain about 10 per cent. of water, in which case the mean nitrogen content is about 0·2 per cent.

MESSRS. PEARL AND SURFACE have issued a further instalment of their applications of correlation methods to poultry problems as Bulletin No. 168 of the Maine Agricultural Experiment Station. The fertility of the eggs, measured by the percentage of infertile eggs, does not appear to be inherited and is to a large degree influenced by external circumstances. On the other hand, the "hatching quality" of eggs, measured by the percentage of fertile eggs hatched, is a character of altogether different nature, being innate, constitutional, and inherited. It is, however, adversely affected by heavy winter egg production, whilst fertility is not. The two characters are not entirely unconnected; there is a small but sensible correlation between them, and a hen the eggs of which run high in fertility will also tend to show a high hatching quality. Both are adversely affected by bad conditions of housing.

IN a lecture given at the Farmers' Club on February 28, Mr. W. Herrod said that the usefulness of the bee in connection with agriculture had not been recognised by farmers in this country until recent years, and even now many looked upon bees as they did on wasps, as insects to be avoided. In some countries the bee was rightly held in high esteem for its usefulness in the production of seeds and fruit. Most plants depend on insects for fertilisation, although in some it is done by the wind. Amongst insects, the whole family of bees are of the greatest use; next come butterflies and moths, while flies even do their share of the work, but it is more especially the hive-bee that is the blossoms' partner, by carrying the fertilising dust from one flower to another. After describing the inhabitants of the hive, Mr. Herrod mentioned how the workers collect the nectar and carry the pollen from one plant to another. He then quoted Darwin, who found that twenty heads of Dutch clover yielded 2290 seeds, but twenty other heads protected from bees produced not one. Then 100 heads of red clover produced 2700 seeds, but the same number of protected heads produced not a single seed. He also mentioned experiments made in America which tended to show the great advantage gained by the fertilisation of clover by bees. That bees are useful to the farmer even with ordinary farm crops, and that some farmers realise this, is proved by the fact that hives of bees are carried into bean-fields just after horse-hoeing, and the plants are about to bloom, so that they may be close to the crop to carry out the work of fertilisation.

PROF. GRENVILLE COLE has issued a description of the raised map of Ireland contained in the National Museum of Science and Art, Dublin. It is at once concise and interesting, and, even without the aid of the raised map to which it refers, may be read with profit by anyone requiring a short but comprehensive review of Irish geological history. The development of the surface features of the country as dependent upon geological events is followed from Archæan times. It is enjoyable reading throughout. The illustrations are good. Some are old friends, but are not the worse for that. All are well chosen.

THE records of horizontal pendulums frequently show series of small oscillations which, in their brief period and long continuance, are quite distinct from those produced by distant earthquakes. In previous papers Prof. Omori has established the remarkable facts that the mean periods of the principal groups of pulsatory oscillations are 4·4 and 8·0 seconds, and that they are approximately constant all over the earth. He has recently returned to the subject in an interesting report (Bulletin of the Imperial Earthquake Investigation Committee, vol. iii., No. 1, Tokyo) on the oscillations observed in the Japanese islands of O-shima and Hachijo, and in two neighbouring districts of Tokyo. The oscillations, he finds, occur more or less at all times on extensive quaternary plains and on large alluvial valleys, but very seldom, and only to a slight degree, at places on granite and Palæozoic rocks. In the islands the oscillations are of frequent occurrence, and their mean period is, as a rule, 4·3 seconds. At Hongo, in Tokyo, three periods exist, with mean values of 2·9, 4·5, and 7·5 seconds, but those with a period of 4·5 seconds occur four times as frequently as those of the longer period. The approach of a deep barometric depression is invariably accompanied by the production of marked oscillations which have a mean period of 4·5 seconds.

Similar instruments installed in two districts of Tokyo, 2·29 km. apart, one on high and hard ground, the other on low and very soft ground, showed that the pulsations at the two places differed not only in phase, but also in their mode of grouping, while the mean period and amplitude were nearly the same.

BULLETIN No. 405, issued in 1909 by the United States Geological Survey, consists of a full account of the prolonged and exhaustive investigations carried out by Dr. W. F. Hillebrand and Dr. W. T. Schaller upon the chemical and physical properties of the remarkably interesting series of mercuric minerals, viz. kleinite, montroydite, terlinguaite, eglestonite, calomel, and native mercury, occurring at Terlingua, Texas. Of these, all, save the last two, are minerals which were first discovered and are as yet known only at this locality. Montroydite, terlinguaite, and eglestonite were first described by Prof. A. J. Moses; he noticed yet another possibly new mineral, but had not at his disposal sufficient material for its determination. The outstanding mineral was subsequently studied by Prof. Sachs, who gave it the name kleinite, and announced it to be an oxychloride of mercury with the formula $Hg_4Cl_2O_3$. One of the most interesting results arising from Dr. Hillebrand's analyses is to show that the mineral has a more complex composition, and is, indeed, a unique example among minerals of the mercury-ammonium group of salts. The precise nature of the molecular constitution, however, still remains uncertain, and it is not known what part is played by the small but varying amount of water present; the mineral may possibly be a mixture of the chlorine compound NHg_2Cl with other salts of mercury. The homogeneity above 130° and the heterogeneity below that temperature, as revealed by the optical characters, show that kleinite must have been formed at a relatively high temperature. Careful tests failed to reveal the presence of nitrogen in any of the remaining minerals, but Dr. Hillebrand found that the formula for eglestonite should be Hg_4Cl_2O, and not $Hg_6Cl_3O_2$, as deduced by Moses from McCord's analyses. Dr. Schaller's careful goniometric examination confirmed the fundamental constants and the symmetry already found by Prof. Sachs for kleinite and by Prof. Moses for the other minerals, but added enormously to the number of forms discovered. Dr. Schaller, who is evidently a whole-hearted disciple of Prof. Goldschmidt, based his discussion of the forms on the harmonic law enunciated by that versatile crystallographer.

THE meteorological chart of the North Atlantic Ocean for March, issued by the Deutsche Seewarte, contains an account of the second attempt at utilising wireless telegrams for weather forecasts. The experiment was made in August and September, 1909, and the district of observation was restricted to 10°–30° W. longitude. The results tend to show that, so far as Germany is concerned, it is doubtful whether practical use can at present be made of the telegrams. The Seewarte considers that further study of the connection between the weather of any particular day in Germany and the preceding distribution of pressure over the ocean, and especially of the tracks taken by barometric depressions, is primarily necessary, and that this study can best be done by an examination of the daily synoptic charts which have been published for many years by the Seewarte and the Danish Meteorological Institute. We believe that similar telegrams were forwarded to the London Meteorological Office; the results, so far as this country is concerned, will no doubt be given in the committee's next annual report.

BULLETIN No. 36 of the University of Illinois consists of a paper on the thermal conductivity of fire-clay at high temperatures, by Messrs. J. K. Clement and W. L. Egy. The fire-clay specimens are cylinders 40 cm. long, 12 cm. in diameter, with a hole through the centre 3·5 cm. in diameter for the reception of a heating coil of nickel wire wound on a porcelain tube. The cylinders are further provided with two long holes 3 mm. in diameter parallel to the axis and extending to the central plane. Through these pass the platinum platinum-rhodium thermocouples, by means of which the temperatures at two points of the central plane are determined. The specimens are enclosed in a fire-clay furnace, which has an internal diameter slightly greater than the external diameter of the specimens. The heating current is measured by means of a Weston voltmeter and shunt, and the thermocouples standardised by means of zinc, silver, or copper freezing in a carbon crucible in a special furnace. The electromotive force of the couple is measured by potentiometer and galvanometer. Two samples gave constant heat conductivities of 0·0026 and 0·0036, respectively, between 300° C. and 800° C., one other increased from 0·0021 at 300° C. to 0·0023 at 700° C., while a fourth increased from 0·0024 at 400° C. to 0·0026 at 800° C.

AN illustrated article on the Royal Liver building, Liverpool, appears in the *Builder* for April 9. With the exception of the outer curtain walls, the building has been constructed entirely in ferro-concrete on the Hennebique system. Mr. W. Aubrey Thomas was the architect, and Messrs. L. G. Mouchel and Partners prepared the details of the ferro-concrete work. The building is 301 feet long by 177 feet 6 inches wide, these dimensions continuing up to the main roof at a height of about 170 feet above street-level. The domes surmounting the main towers are 295 feet above street-level, the extreme height from foundation-level to the topmost point being 360 feet, about the same as that of St. Paul's Cathedral. This huge building has eleven storeys up to the main roof, and six storeys in each main tower. From the structural point of view the building is essentially a monolith. Each floor was moulded at the same time as the corresponding columns and beams, so that the men engaged in setting up the framework of the next storey had the advantage of a continuous floor for the conduct of operations. The granite curtain walls constituting the exterior sheathing of the building are nowhere more than 14 inches thick, the weight being taken at each storey by lintels forming part of the general framework.

THE first of a series of illustrated articles on the construction of aëroplanes appears in the *Engineer* for April 8, and deals with the Farman biplane. This machine has the distinction of being the first to combine the rear planes for steadying purposes with ailerons or fins for obtaining lateral stability. Mr. Farman began his career in aviation as pilot of a Voisin biplane, a machine which depends for stability on its cellular construction. Farman drifted from the cellular aëroplane, and adopted the system of manual control which in various forms is now almost general. In the new Farman machines the planes have a supporting surface of 48 square metres. The older types have two planes of the same length, whereas the new machines have the lower plane shorter than the upper, the lengths being, respectively, 23 feet and 36 feet. The width and the height between the planes are equal, being each 6 feet 2¾ inches. Both ash and poplar are used in the construction. Most Farman biplanes are fitted with the rotary Gnome engine. A feature of the article is the numerous clear drawings of details given.

OUR ASTRONOMICAL COLUMN.

APRIL SHOOTING STARS.—Mr. Denning writes:—"The gibbous moon will be present in the sky during the ensuing return of the April Lyrids, so that a conspicuously visible display can hardly be expected. The night of April 21 will probably be the time of maximum, but nothing can be definitely predicted as to the strength of the coming shower. It seems to vary from year to year in an irregular manner, and has seldom presented a rich display comparable with that of the August Perseids.

"In 1909 there were few of the April Lyrids visible, though the skies were very clear on the important nights of April 20 and 21.

"The shower is, however, a very brief one, and often evades English observers by occurring in the daytime or at a period of cloudy weather or bright moonlight. It is a system which certainly requires much further observation, though it seldom provides us with a spectacle of abundant and attractive character; but it may return at any time and present a repetition of the splendid shower witnessed in 1803, so that it should be carefully watched every year."

HALLEY'S COMET.—The Cape Town correspondent of the *Daily Mail* announces that Halley's comet was observed, after its conjunction with the sun, at the Cape Observatory at 5h. 50m. a.m. on April 8. The comet was visible for ten minutes before becoming lost in the increasing daylight, and is reported as being brighter than when seen in February. The comet was observed at the Vienna University Observatory shortly before 5.0 a.m. on April 11, and was seen also at the Perth Observatory, Western Australia.

In No. 421 of the *Observatory* (p. 182) it is suggested that, as Dr. Wolf saw the comet as a naked-eye object on February 11, the estimated magnitude (9·0) given for the end of February must have been far too low; on the assumption that the brightness varies as $1/r^4\Delta^2$, the comet should be at least as bright as the first magnitude when near the earth on May 20.

The question of the comet's brightness during May is also discussed by Dr. Ebell in No. 4400 of the *Astronomische Nachrichten* (p. 140). Taking the recorded magnitudes, at various intervals from perihelion, during the apparition of 1835–6, and comparing them with those already recorded for the present return, Dr. Ebell finds that the apparent magnitude at the time of greatest brightness, May 21, may be about −1·7, or about equal to that of comet 1910*a* at its perihelion. On this basis the present magnitude is about 4·0, and the comet should remain a naked-eye object until about the end of July.

A photograph of the comet taken at Juvisy on February 12 is reproduced in the April number of the *Bulletin de la Société astronomique de France*; at that time the tail showed as a feeble, fine trace about 1½° long. Another photograph was taken on March 7 with nineteen minutes' exposure, but only a feeble image of the head was obtained. A drawing by M. Baldet, made on March 5, when the magnitude was estimated as 6·0, shows a V-shaped appendage, the angle between the two tails being 70°, and the southern tail being the faintest and shortest.

Reports from various countries emphasise the necessity for spreading sound knowledge concerning the comet. The suicide of a Hungarian farmer "on account of Halley's comet" is followed by a report from Odessa that in southern Russia there is a veritable popular terror, which is being exploited by unscrupulous persons for the purpose of obtaining money, for special prayers, &c., from the ignorant natives. We welcome, therefore, a brochure received from the Manila Weather Bureau, in which Father Zwack carefully analyses the alleged sources of catastrophe, and shows how utterly puerile they are. Such brochures, if printed in the vernacular, would do a great deal towards allaying excitement, which otherwise may lead to serious trouble.

COMET 1910*a*.—A number of observations of, and an ephemeris for, comet 1910*a* are published in No. 4400 of the *Astronomische Nachrichten*. Among the former are some, made near the end of January, by the late M. Charlois at the Nice Observatory, and an interesting set communicated by Dr. Ristenpart from the Santiago Observatory. At Santiago they picked up the comet about three-quarters of an hour before noon on January 19 (23h. 15m., January 18), and followed it until after 6 p.m.; at the time of the first observation it was only 7° east and 3½° north of the sun. Herr Castro, who made the position settings during the afternoon, noted a striking falling off in the apparent brightness of the comet during the 2½ hours he had it under observation.

THE GALACTIC SYSTEM, ITS STRUCTURE AND ORIGIN.—An interesting discussion of the galactic system, its structure, origin, and relations in space, is published—in English—by Dr. Karl Bohlin in No. 10, vol. xliii., of the *Kungl. Svenska Vetenskapsakademiens Handlingar*. Having observed a large number of nebulæ and clusters, and, in a previous paper, discussed the measures of the globular cluster M. 92, Dr. Bohlin was induced to take up the study of the distribution of the various classes of the heavenly bodies, and commenced with that of globular clusters. From this point of view he has studied the distribution of a large number of these objects, and concludes therefrom that their system is situated in the centre of the galactic system, for only on this assumption can their apparent clustering on one side of the galactic circle be explained. Extending the study to various other classes of celestial objects, the author evolves a systematic evolution of them which accounts for their apparent distribution and various forms. In this hypothesis planetary nebulæ originally consist of rotating luminous shells filled with very tenuous matter. These shells, breaking down at their poles, form apparent "ring" nebulæ with distinguishable nuclei. The galactic system is supposed to have been such a planetary nebula, having reached at present an advanced form of ring nebula, of which the system of globular clusters forms the nucleus; the spiral nebulæ, clustered near the poles, parts of the broken shell; and the Milky Way, the equatorial belt. Diagrams illustrating these distributions, and twenty-seven reproductions from photographs of various nebulæ, are shown on the six plates accompanying the paper.

SATURN'S SATELLITES AND RINGS.—In No. 610 of the revived *Astronomical Journal*, now edited by Prof. Lewis Boss, Prof. Barnard records some measures of the eclipses of Saturn's satellites, made by him during 1906–8. The measures are given in detail, and some interesting notes on the dimming of the satellites Rhea and Dione, immediately before the final disappearance, are appended. In the case of the former the loss of light amounted to as much as 2·0 to 2·5 magnitudes. Measures of the relative distances of the satellites and of the position-angles of the rings during the same period are also given.

THE SYSTEM OF ϵ HERCULIS.—From the investigation of a large number of plates taken at the Dominion Observatory, Ottawa, Mr. Harper has re-determined the orbit of the spectroscopic binary ϵ Herculis, and finds several departures from the elements determined from the 1907–8 spectrograms. The period, according to this later determination, is 4·0235 days, and is a varying quantity (the Journal of the Royal Astronomical Society of Canada, No. 5, vol. iii.).

THE GAZELLES OF SEISTAN.[1]

MAJOR R. L. KENNION, British Consul at Seistan, has had the good fortune to bring to light what are practically two new species of gazelle from the Kain and Seistan districts of eastern Persia, specimens of both of these, presented by Major Kennion, being exhibited in the Natural History Museum. Of the first of these species, typified by the mounted head of a buck from Kain, two notices by myself appeared in the *Field* newspaper for 1908 (vol. cxi., pp. 70 and 499). In the earlier of these it was compared to the Atlas or edmi gazelle (*Gazella cuvieri*) and Merrill's gazelle (*G. merrilli*) of Palestine, with the former of which, and probably also with the latter, it agrees in the presence of horns in the female. Compared with the type-skull of Merrill's gazelle figured by Mr. O. Thomas in the Proceedings of the Zoological Society for 1904, vol.

[1] Communicated by permission of the Trustees of the British Museum.

ii., p. 348, the head of the Kain gazelle differs by its larger ($11\frac{1}{4}$ inches) and more fully ringed horns, the number of rings in this specimen being sixteen, and also by their less distinctly s-shaped curvature in profile, and rather more sublyrate form when seen from in front. In the general contour of the horns, the characters of the face-markings, the very tall ears, and the large bodily size, this gazelle comes, indeed, very close to the edmi, and in all these respects differs from the goitred gazelle (*G. subgutturosa*) of western Persia, as it also does by the smaller extent of the white area on the buttocks, which does not reach up to the root of the tail, but is restricted to the inner sides of the thighs. In this latter feature, shown in a mounted specimen, the Kain gazelle agrees with the Indian *G. bennetti*, from which it differs by its superior size (shoulder-height of a fully adult buck probably about 28 inches), larger ears, and more distinctly sublyrate and slightly incurving horns.

In the second notice I compared the Kain gazelle with the Yarkand gazelle (which I regard as specifically distinct from the goitred species), and named it *G. yarcandensis kennioni*, not being then aware that it differed by the presence of horns in the female and the smaller amount of white on the buttocks. The name *kennioni* would stand as a specific title were it not that in the Proceedings of the Zoological Society for 1873, p. 317, Dr. Blanford described a horned female gazelle from Jalk, on the Baluchi border of eastern Persia, as a new species under the name of *G. fuscifrons*. In a paper published in the same volume, p. 545, this species was recognised as valid by the late Sir Victor Brooke, who particularly referred to the large size of its ears as a distinctive feature, especially as compared to *subgutturosa*. Later on, however, Dr. Blanford, in the "Fauna of British India" (where Jalk is stated to be in Baluchistan, although in "Eastern Persia," he had rightly referred to it as forming the southern edge of the Seistan desert), identified *fuscifrons* with *bennetti*, on the ground that a male obtained by Sir O. St. John appeared inseparable from the latter. From the fact, however, that the Kain district, which is the northern continuation of the Seistan desert, is the home of a large gazelle allied to *bennetti* in the presence of horns in the female and the small extent of the white area on the rump, but with larger ears and rather more sublyrate horns, there can be no doubt that this gazelle is no other than *fuscifrons*, which must be re-established as a species. *Gazella yarcandensis kennioni* therefore becomes *G. fuscifrons*, although Kennion's gazelle may be retained as the English name.

This being so, it is doubtful whether the Indian *G. bennetti* really occurs in Persia at all. In "Eastern Persia" Dr. Blanford stated that he obtained a male referable to that species from the Bampur district of eastern Persia (alluded to as being in Baluchistan), which differed from Indian examples only in some details of the horns, adding that he believed this gazelle to extend on the lowlands to the head of the Persian Gulf, while above the 3000-foot contour it was replaced by the goitred gazelle, distinguishable, even at a distance, by its lighter colour. From the new evidence it appears that the lowland gazelle of the Persian Gulf is *fuscifrons* rather than *bennetti*.

The second of the Seistan gazelles is represented by an adult male standing about 39 inches at the shoulder, and characterised by the great size of the ears, the marked incurving of the tips of the sublyrate horns, and the small extent of the white area on the rump, which does not reach the root of the tail. In most of these features this species resembles the Yarkand gazelle, as it also does in the absence of horns in the female, although it differs by the small extent of the white on the rump, which in the Yarkand species (plate v. of Blanford's "Mammals of the Second Yarkand Mission") is very large and ascends high up on each side of the root of the tail. This gazelle greatly exceeds *subgutturosa* in size, as well as in the much larger ears, less divergent horns, and the smaller white rump-patch, but resembles that species in that the male has a "goitre." Taking the mounted specimen in the museum as the type, it may be known as the Seistan gazelle, *G. seistanica*.

The foregoing species collectively indicate a transition from the edmi and *bennetti* type on the one hand, to that of the goitred gazelle on the other, as is indicated in the case of some of the Asiatic species by the following table:—

(*a*) Females horned; no goitre; tips of horns not distinctly inturned; rump-patch small.

(1) Indian gazelle—*G. bennetti*.

Height about 25 or 26 inches; ears moderate; no inturning of horn-tips.

(2) Kennion's gazelle—*G. fuscifrons*.

Larger, height probably about 28 inches; ears longer; horn-tips slightly inturned.

(*a'*) Females (except *marica*) hornless; a goitre; tips of horns distinctly inturned.

(*b*) Rump-patch small; face-markings distinct.

(3) Seistan gazelle—*G. seistanica*.

Very large; height about 29 inches; ears very long; horns sublyrate.

(*b'*) Rump-patch large.

(*c*) Face-markings; horns sublyrate; colour dark.

(4) Saikik, or Yarkand gazelle—*G. yarcandensis*.

About the size of last, but ears apparently shorter.

(*c'*) Face-markings nearly obsolete; horns divergent; colour in winter very pale.

(5) Goitred gazelle—*G. subgutturosa*.

Size small, 24 to 26 inches; ears short; females hornless; dark lateral band faint.

(6) Marica gazelle—*G. marica*.

Ears taller; females horned; dark lateral band distinct.

The African edmi, and probably the Syrian Merrill's gazelle, come in the first group. The Mongolian *G. gutturosa* is a larger member of the last group, distinguished by the small size and peculiar form of the horns of the bucks, which do not diverge after the fashion of *subgutturosa*. The Central Asia *C. przewalskii* is another allied type.

Certain immature gazelles from Eastern Persia now exhibited in the Zoological Society's Gardens as *G. subgutturosa* are apparently *G. fuscifrons*.

R. LYDEKKER.

BOURNES; OR INTERMITTENT SPRINGS.

INTERMITTENT streams break out in our chalk valleys when there has been a partial return to the conditions of rainfall prevailing during the period of the excavation of the valleys. The effect of a heavy rainfall is not seen immediately. A bourne may, indeed, break out during a temporary drought following. Its immediate cause is the rise of the saturation-level until it intersects the bottom of the valley. The water then rises out of the ground, and flows until the curve of saturation sinks by reason of the relief afforded by the flow. While still rising, the bourne will make its appearance at successive points higher and higher up the valley.

These bournes afford a valuable clue to the method of formation of dry chalk valleys. Given a period of greater rainfall, and the permanent rise of the saturation-level would give a permanent stream, with considerable powers of excavation. Flints lining the bed of the Croydon Bourne are covered with a calcareous incrustation, so that solution and corrasion would both do work in the formation of the valley.

The earliest record of the Croydon and other bournes has been traced by Mr. Baldwin Latham to Warkworth's "Chronicle," which shows that in 1473 "womere watere ranne hugely." Bournes rose at St. Albans, Lewisham, and Canterbury, as well as at Croydon. In Leland's "Itinerary" reference is made to a bourne at Drelingore, near Dover, and this was also flowing in 1904, the year of the last great flow of the Croydon Bourne. In Yorkshire, the vipsies or gipseys are apparently similar to bournes. "Nailbourne" is a name formerly given to them in Kent, or, with a corruption of the spelling, "Eylebourn." "Wellesbourne" and "Winterbourne" are also met with. The Hertfordshire Bourne, which has again been active this year, was formerly known as the Wenmer, or Womer. This is referred to by Camden as breaking out near Watling Street. Childrey (1661) says that it is popularly believed that it never "breaketh out but it foretelleth dearth and scarcity of corn, or else some extraordinary dangerous times shortly to ensue." This, indeed, was a very customary superstition in connection with all these

bournes. Pestilence and plague followed them; but we can safely say that the share that they had in these results was to disturb the filth of previous years which had accumulated in their channels, and when they ran through undrained villages to scatter the germs of disease far and wide.

Croydon may be regarded as the centre of a number of bournes. In addition to that known as the Croydon Bourne, there is what was, no doubt, once its tributary bourne, the Merstham or Marlpit Lane Bourne. There was formerly one in the Wickham Valley, and others at Cheam, Carshalton, and Epsom. The Merstham Bourne, which is also flowing this year, yielded, according to Mr. Latham, 1,108,530 gallons a day on March 21 at Stoat's Nest. This now rises in a culvert which was made to receive the waters, when the springs ran high, in the building of Merstham Tunnel, and it follows the valley northward towards Croydon, but sinks into the ground, as it has from time immemorial, at Red Lion Green, Smitham Bottom. This disappearance has not yet been explained. If it continued a mile and a half further along the valley it would join the Croydon Bourne at Purley, and together they would proceed by the bourne culvert to swell the volume of the Wandle where it emerges from beneath Croydon.

The present flow of the Croydon Bourne is not so extensive as that of 1904, when its point of origin gradually receded from the grounds of the "Rose and Crown," Warlingham, and the gasworks, which became completely surrounded with water, to the Marden Valley, which it entered, as far as Bughill Farm. Thence the dry chalk valley winds away to the escarpment, and we may reasonably conclude that the stream formerly filled the whole valley. This year, although the gasworks at Whyteleafe have a fair amount of water in the field around them, the rising point has fallen short of Bughill Farm, and in the opposite direction has not reached Purley. Its yield was, however, reported by Mr. Latham as 2,300,980 gallons a day on March 21 at a spot below the "Rose and Crown." There is no regularity in the appearance of the bourne. It last was seen in the winter of 1903–4, and previously in 1897. There were annual flows from 1876 to 1883 inclusive, and it is interesting to note that Mr. Latham has accurately predicted the last fourteen flows from the rainfall measured in numerous stations on and about the Downs.

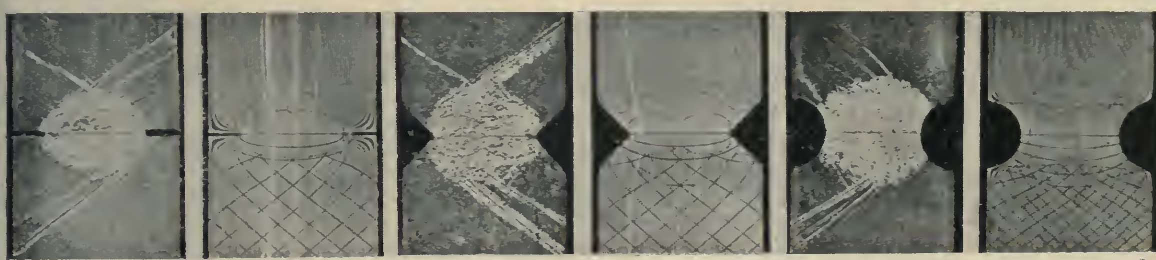
E. A. M.

STRESS LINES AND STREAM LINES.

THE general conditions of stress at any point in a loaded body have been reduced to certain mathematical equations, but there is considerable difficulty in applying these equations to any but the simplest cases. Experimental methods, therefore, are welcome, though they may give only approximations to correctness. One such method consists in deducing the stresses from the distortions produced by the load. The application of this method is frequently very difficult, but it has been simplified by the discovery and study of the phenomenon known as Lüders' lines.

Lüders' lines are markings which appear upon the surface of an iron or steel bar when permanently deformed, and they indicate the locality of the distortion. Observations show that these lines, in simple cases of loading, have an inclination of about 50° to the direction of maximum principal tension. Assuming that this inclination remains the same under more complex conditions of loading, it becomes possible to construct—at least in direction—the system of maximum principal tension from the lines of Lüders found upon a distorted piece. This method has been employed with some success, but it suffers from certain disadvantages. When the variation of stress is considerable, only those parts of the bar where the stress is greatest show any lines, unless the piece is so much deformed that the original distribution of stress is greatly altered. Thus the constructed stress system is either incomplete or inexact.

A more useful method is suggested by the similarity in the problems of elastic solids and of viscous fluids. Stress lines, which are lines of stress direction in a solid, possess certain points of similarity with stream lines, which are lines of flow direction in a liquid. In order to verify this connection, the comparison has been made between the stream system and the corresponding stress system for a number of two-dimensional cases.[1] The method employed consists in subjecting a steel bar of uniform thickness, but of varying width, to a tensile load, until a number of Lüders' lines are developed. The corresponding flow diagram is obtained, by means of the well-known Hele-Shaw apparatus, for a channel of the same outline as the bar. The position of one point on each line of Lüders is



(1) (2) (3) (4) (5) (6)

Steel bars 2½ inches wide, ¼ inch thick, reduced in width to 1½ inches by means of (1) two saw cuts, (3) two angular notches of 90°, (5) two semicircular notches. The light bands are the lines of Lüders. The fine dark lines have been transferred from the corresponding flow diagrams (2), (4), and (6).

transferred to the flow diagram, and the form of a line of distortion passing through this point is constructed geometrically, assuming that the stream lines represent stress lines, and that the inclination of the lines of distortion to these is 50°. The constructed line is then superposed upon the corresponding line of Lüders; any divergence is an indication of a defective method or of faulty construction.

The figures illustrate the results of three such cases. Although the correspondence between the constructed lines and the actual lines of Lüders is not perfect, due chiefly to certain inherent defects in the method, there seems little doubt that in these cases the stream-line system is a fairly accurate representation of the system of maximum principal tension.

G. H. G.

SCIENTIFIC KNOWLEDGE AND INDUSTRIAL DEVELOPMENT.

THE prizes and certificates of the successful students of the Bath Technical School were distributed by Principal E. H. Griffiths, F.R.S., of the University College, Cardiff, on February 2, when he delivered an address in which our educational system was discussed, and the value of technical education emphasised. We are indebted to the account of the proceedings in the *Bath Herald* of February 5, and to *Pen and Pencil* for November, 1909, for the facts contained in the following summary.

[1] "A New Experimental Method of Investigating Certain Systems of Stress." By G. H. Gulliver. Proceedings of the Royal Society of Edinburgh, Session 1909–10, vol. xxx., part i. (No. 3).

The latter periodical, which is issued by the students of the Cardiff Technical School, published a short article dealing with the value of science in industry by Principal Griffiths, which he elaborated in his address.

Principal Griffiths said that personally he prefers the words technical education rather than technical instruction, because we want in a technical school to do something more than the beginnings of a trade; we also want to expand the horizon, increase knowledge, and increase their abilities apart from the increased power it gives the students of earning their living later in life. We are, he continued, passing through a time in which there are certain difficulties naturally arising. There is no doubt that in the last ten years there has been a marked change in the aspect in which the question of education is regarded by the people, and those who need it. In such a time of change, as well as the advantages, there are dangers. We are spending an enormous sum of money—26,000,000*l.*—from Imperial sources in educating children to read, write, learn arithmetic, and so on. Into the hands of these children weapons are being put, and then they are not taught how to use them. It is a fearful blot on the whole educational system of the country that we spend millions and millions of pounds in laying foundations, and do nothing further. A great portion of the money is wasted, and if it were not for the existence of technical schools and the continuation classes the situation would be worse still. The time must come, said Principal Griffiths, when, if the educational system of the country is to be used to the best advantage, it must be recognised that young people, on leaving primary schools, and not able to get the advantages of secondary education, must be compelled to give a certain portion of the time between the ages of sixteen, seventeen, and eighteen to studying something which may be of value to them in after life.

Dealing with technical education, he insisted that the prosperity of this country depends upon its industries, and that its industries are dependent on the application of science. The truth of the former statement, he said, will be generally admitted, but as regards the latter there is some scepticism. It is difficult, for example, to see the direct connection between the zoologist peering through his microscope and dissecting the minutest insects, and the progress of a great commercial undertaking. The connection is, however, close and real. Take, for example, that great work now in process of accomplishment, the Panama Canal. The man who successfully constructed the Suez Canal was defeated in Panama, not by the physical, or even the political, difficulties, but by malaria and yellow fever. It has been stated that in the enormous work which was done before the project was abandoned by the French, a human life was sacrificed for every cubic yard of earth excavated. This is now a story of the past, and the death-rate amongst the workers to-day but slightly exceeds that prevalent in many of the American States. How has this change come about? No small part has been played by the School of Tropical Medicine established by the University of Liverpool.

An elaborate and prolonged investigation, in the course of which valuable lives were unfortunately sacrificed, resulted in the discovery that the dissemination of both malaria and yellow fever is due to so insignificant a creature as a certain species of mosquito, a discovery which will undoubtedly have a profound effect, not only on such undertakings as the Panama Canal, but on the march of civilisation in the future.

It is interesting to reflect that this discovery, like many others which have profoundly affected the commercial community, has been made by men without any thought of financial return, but who have been prompted solely by their love of research and their desire to add to the common stock of knowledge of mankind. It is not too much to say that every increase in natural knowledge will ultimately prove to have its use and application in the affairs of daily life.

Faraday was the first to establish the fact that an electric current may be generated by the movement of a conductor in a magnetic field. When he first exhibited at the Royal Institution the crucial experiment which vindicated his reasoning in this matter, a lady afterwards inquired, "But if so, Prof. Faraday, what is the use of it?" His reply was a memorable one, "Madam, will you tell me the use of a new-born child?" Reflect for a moment on the fruits of Faraday's discovery. True, numerous improvements have been made in the practical application of the principle by many workers, but all the applications of electricity which are now so frequent as to be regarded as familiar are based on the production of electricity by the expenditure of mechanical energy. Wherever a dynamo is used, there you have an application sprung from the brain of Faraday.

Mr. Stanley Jevons has made an approximate estimate of British capital invested in electrical undertakings which may be regarded as dependent on the mechanical generation of electrical power. It is safe to say that at least 185,000,000*l.* of capital are thus employed, and profitably employed, not only in increasing the comfort and welfare of the population as a whole, but in affording employment which otherwise would be wanting.

Examples of a similar kind could be multiplied almost indefinitely; but they are mentioned not so much to establish a proposition as to direct attention to the importance of scientific investigation, not only on its academic side, but also from a practical point of view.

It is by a recognition of this truth that Germany has in recent years outstripped us in some respects in the industrial race, and it is to such institutions as our technical schools and the laboratories of our colleges that we must look for the supply of men who are in the future to restore, if possible, the supremacy which seems to be passing from us. It must be remembered that not only must research receive encouragement, but we must train men in whom this country, as compared with both Germany and the United States, seems somewhat deficient—men who have sufficient scientific knowledge and ability to comprehend the discoveries of others and to apply such discoveries to the practical affairs of life. Men who can act as intermediaries between the laboratory and the market-place it is the special mission of our technical schools to supply.

In conclusion, Principal Griffiths commented on the fact that the man of business is not now as cynical of science as once he was, and, observing that no scientific discovery is useless, he added that there is nothing more likely to advance science than the institution of technical schools.

AËRONAUTICS.[1]

Any sensation of "wind" felt in a dirigible balloon is only that due to the independent speed of the balloon. It will always be the same, whether it be a following or a head wind, neither more nor less intense, because the surrounding wind is nothing but a movement of the atmosphere in which the balloon is submerged. Relatively to the ground below, a dirigible balloon may be going with the wind at 100 miles per hour, or against the wind making headway only at five miles an hour. If its engine be working at the same power in each case, the speed of the vessel relatively to the atmosphere is the same. Its envelope is only calculated to sustain the speed of which its engines are capable, and its stability depends upon a certain pressure of air not being exceeded. Bear in mind that wind is a body of calm air moving more or less rapidly. To the aëronaut wind does not exist. He is in calm: the earth is moving. A dirigible balloon may be in a current of air moving, say, from west to east at twenty miles per hour. With whatever speed it may be capable of, the balloon can move freely about in that current. The flow of air is always from the bows to the stern, and it is always of exactly the strength given by the independent speed of the airship.

No analogy of any marine vessel except the submarine is of any use to us; for in the ship you have either got a sail giving you leverage on the air, or you have the leverage of your keel or propeller giving you power against the wind. An airship cannot "tack" after the manner of a marine vessel. Nothing is to be gained by adopting a zig-zag course.

In mechanical flight the action of the air on the upper

1 Abridged from Reports of Cantor Lectures delivered at the Royal Society of Arts by Mr. C. C. Turner and published in the Journal of the Society.

side of a plane has nothing whatever to do with lifting power. For instance, there is the familiar experiment with paper sometimes brought forward to show that the air passing over the back of the plane lifts it. As Phillips believed, it creates a vacuum on the upper rear extremity, and the paper naturally is pressed upwards; but let me explain the fallacy of the argument which seeks to show that the upper side of the plane therefore gives lifting power. If that piece of paper were free in the air, it would not matter how hard one blew on its upper surface it would not lift. It is only when it is held, in fact; and

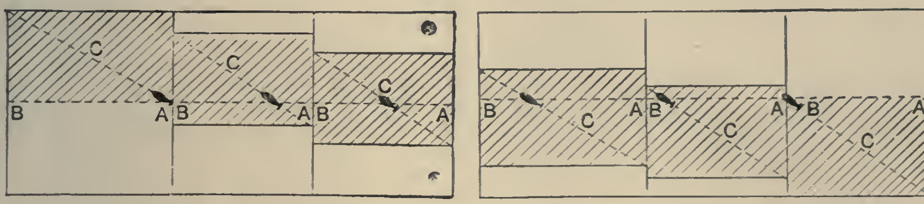


Fig. 1.—Course of Airship against Side Wind. A, starting-point. B, destination. The shaded portion is a moving body of air, *i.e.* the wind. The diagonal line, C, is the path of the airship with regard to the air. The dotted horizontal line is its path with respect to the earth.

the lifting power is derived entirely from the expenditure of energy. The harder one blows the more it lifts. The power to rise is derived entirely from the energy with which one blows, or, in the alternative of a plane being driven through the air, entirely from the energy of the motor. There is no lift at all without the expenditure of power by the engine.

Scarcely any of these theories of the action of the air on the back of the plane have been mathematically formulated. Indeed, we are only on the threshold of the science.

No analogy of the behaviour of other fluids is of much use when we come to deal with the air. The air is not

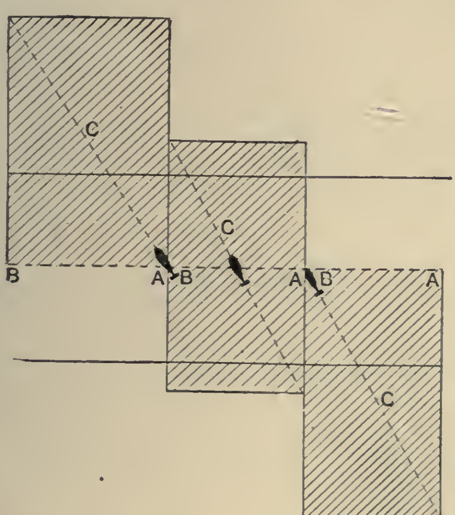


Fig. 2.—In this case the wind is stronger, *i.e.* a longer body of air passes in the same time. The airship therefore has farther to travel with regard to its passage through the air and takes longer in order to arrive at B. Apparently, while the airship keeps to a much greater angle, it moves along the dotted line A. B.

a perfect fluid. It is a very turbulent fluid. There are vortices and reverse movements at the back of the plane. Practically nothing is known of the mathematics of the subject. The leading mathematicians are silent, and I have observed that the only theorists putting forward their conclusions as if they were capable of scientific proof are minor men of science. It is very necessary at present to keep an open mind. Sir George Greenhill and Mr. Horace Darwin, who have been appointed to the Aëronautical Advisory Committee, have not yet issued any statement as to their researches—not that they are unwilling, but probably because they are unable at present to speak with any certainty.

It seems a long way from cricket to flying, but a remark by Mr. P. F. Warner in an article on modern bowling the other day suggests an important consideration for aviators. The great cricketer was discussing "swerving" balls, and he said, "The heavier the air the greater the cushion, and in the thick, smoke-laden atmosphere of Sheffield or Bradford Hirst will swerve infinitely more than in the clearer and brighter climate of Sydney, Adelaide or Johannesburg." It is scarcely necessary that we should point out the application to flight. An aëroplanist who found it easy to sustain flight at twenty miles an hour when near the ground might, on attaining an altitude of 4000 feet, find it necessary to increase his speed to forty miles an hour, or, rather, he could never get so high unless his engines were capable of giving the increased speed.

An attempt to secure some measure of stability is to place the planes at a dihedral angle, as in the Antoinette monoplane, in which the wings extend from the body in the form of a shallow **V**. This method was also formerly used by Blériot, but the tendency nowadays is to have horizontal and even slightly concave surfaces for the sake of the economy of surface involved. Now if Blériot reverted to the dihedral plane, he would have to make his machine two or three feet longer on each side. The dihedral plane is also wasteful of power. Instead, as we have seen, he relies entirely on the wing-warping arrangement for stability.

Cocking tried an inverted parachute in order to secure a steady fall instead of the swinging movement which all parachutists have to endure. It is true Cocking's apparatus gave way under the strain, but in any case it is quite certain that he did not give large enough diameter to his parachute, made on that principle, to sustain him.

This brings us to the discussion of a rather contentious point—that of the suspended centre of gravity. We have seen how early gliders depended below the sustaining planes. Now, in the Antoinette the weight is carried on

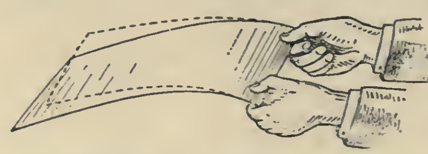


Fig. 3.—A Paper Experiment. The effect of blowing on the forward edge of a curved plane. Dotted lines show how paper rises.

the same level as the sustaining surface. Well, in the Blériot cross-Channel machine the centre of weight is slightly below the sustaining surface. In the Santos-Dumont it is considerably below. In the newest Blériot it is also well below, and in the Chauvière monoplane it is as much as 3 feet below. Now from what has been already said it will be seen that this secures stability only in the very smallest degree, and that the weight would have to be 30 or 40 feet below in order to secure the desired effect; and then you could never get the driving power necessary; but it is probable that M. Blériot, M. Santos-Dumont, and M. Chauvière, in constructing their machines in this way, have an eye, not to improve stability, but to other advantages. By this method they can obtain various constructional advantages, above all, a continuous leading edge by which they greatly economise lifting power. In short, they manage with a smaller machine. They make no effort, be it noted, to rely any less upon their wing-warping arrangements.

An aëroplane must travel at a certain speed to support itself at all. To enable it to rise to a higher altitude the power must be increased. There is, of course, a margin

of variability; but beyond this margin merely to point the elevating rudder at an increased angle is insufficient. You can obtain ascensional power at the expense of speed, but there is a point below which the speed must not be reduced.

There is, as we have seen, a natural speed for an aëroplane, and this natural speed is only elastic within limits. A remarkable variation on one machine was shown by M. Delagrange at Doncaster. With a cross-Channel Blériot, to which he had attached a 50 horse-power Gnome motor, flying with the wind, he flew at a rate of forty

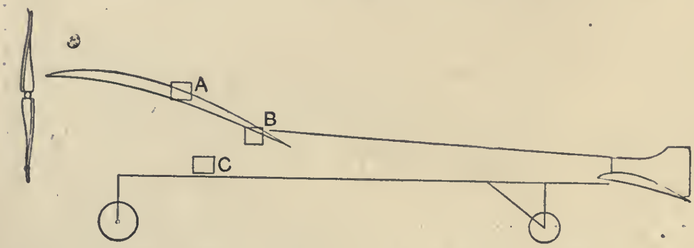


FIG. 4.—Position of Pilot. A, Antoinette, R.E.P. B, Blériot. C, Santos-Dumont.

miles per hour. On the very next day, in a dead calm, with the same machine, he flew at the rate of fifty miles an hour. The difference, which was equivalent to 20 per cent., was due to the fact that he was getting more work out of the motor. On the same type of machine, with a 25 horse-power Anzani motor, the best speed was only about thirty-three miles per hour. M. Delagrange said he could vary the speed 30 per cent. Another instance of driving a flying machine with increased power has been provided by M. Santos-Dumont, who put a 40 horse-power motor to his little monoplane, which gives about 300 per cent. more than the usual proportion of power to lifting area.

Now to obtain great variability of speed we shall have to have lifting surfaces that can be enlarged and diminished at will, and correspond with different engine-power.

The most scientific attempt to obtain the variable plane area is on the Chauvière monoplane, in which, while, in present designs, the leading edge remains rigid, the plane is quite flexible, and the rear edge can be let forward or pulled back by the tightening or slackening of cords, so that the width of the plane is either narrow or broad. When narrow, for high speed, the pressure of the air bulges the plane to an increased curve.

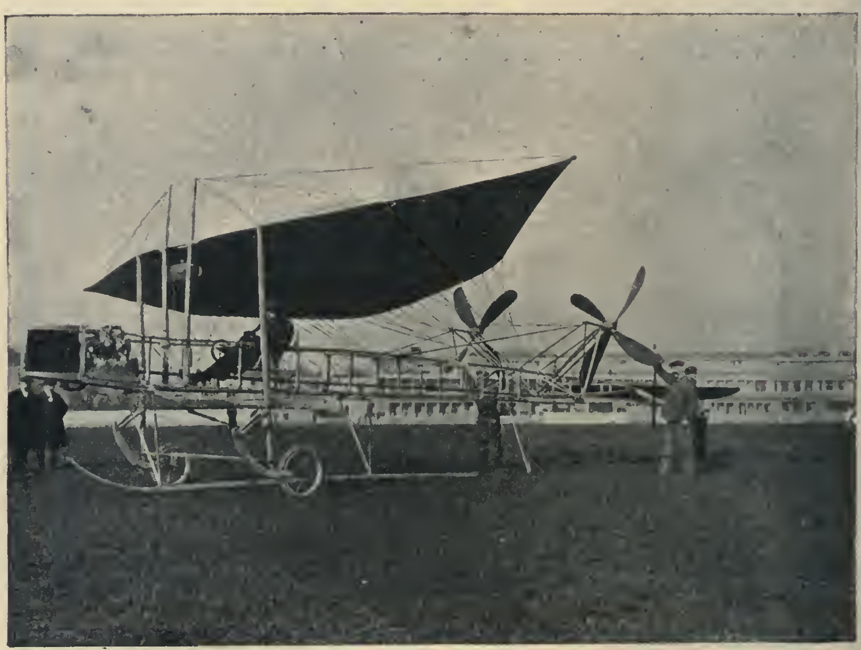


FIG. 5.—The Chauvière Monoplane. An attempt to embody the principle of the variable lifting surface. The plane has a rigid leading edge, but is itself simply a sail. In flight the pressure of air underneath gives it a camber. The rear edge can be slackened and tightened at will to suit different speeds, the sides alternately or in unison.

As to the development of the flying machine, differentiation will, in the main, respond to certain demands. We can clearly foresee development with both monoplane and biplane.

The racing aëroplanes will probably be monoplanes with comparatively small lifting surface, high speed giving the necessary lifting-power. The racing aëroplane will not carry a great weight, and the power of the engine will be required for driving at a great speed without more waste of energy than is unavoidable. It is, of course, an axiom that the greater the speed the less the waste of power. Monoplanes will very probably develop into a permanent racing type.

The near future will see machines in which three or four passengers can be carried, and in which the control can be in the hands of two pilots. Sooner or later we shall get the machine attempted with two motors instead of one; and quite certainly we shall have the machine with variable lifting surface and variable power.

We know that an aëroplane can descend safely on to water. M. Latham did that in his attempt to cross the Channel. Soon we shall have machines that can ascend from water.

. . . .

The use of dirigible balloons, especially in this country, where strong breezes are common, calls for airship harbours at frequent intervals. Probably shelter walls capable of being turned round to the wind in any direction will be used. Each will have a staff of attendants, and the walls will not always be standing erect, but will be so made that they can be run up in a few minutes whenever an airship approaches and signals its need. To have them every ten miles or so all over the country always standing would be intolerable.

An airship has nothing to fear from any wind while she is in the air, but on landing even an ordinary breeze may wreck her. It is all very well for the Germans to show us what they can do with dirigible balloons, but in the great central plain of Europe there is comparatively little wind. They are not handicapped as we are; but in this country so frequently and quickly do strong winds spring up that it may be doubted whether any airships that could not be quickly deflated would be of use. We may discover that we can only employ the semi-rigid and the nonrigid balloon. The rigid balloon at Barrow may be a big blunder after all.

A NATIONAL SYSTEM OF TECHNICAL EDUCATION.[1]

THE problem of remedying the admitted inefficiency of our present methods of technical education, and of invigorating the industries of this country with progressive scientific spirit, while at the same time increasing the

[1] From a paper read before the Association of Teachers in Technical Institutions (West Yorkshire Branch) at Leeds, on April 2, by Dr. Robert Pohl.

supply of skilled workmen, is of the greatest national importance, and is a problem the solution of which, in view of international industrial competition, becomes daily more pressing. It is only natural, therefore, that expressions of discontent with the present conditions, and suggestions for improvement, should be heard from many sides; they come, not only from the educationists, but also from the employer, the representatives of the working classes, and the ratepayers, and with especial force from the social reformer; finally, we hear from Cabinet Ministers themselves that legislation on the subject is under consideration.

If we proceed to analyse the expressions of opinion, as revealed during the last twelve months in special papers, presidential addresses, reports and discussions, too numerous to refer to individually, there is a clear indication that, barely concealed under a superficial diversity of view-point, the ideas have already crystallised round two fundamental principles which are certain to form the basis of all future constructive work.

These are :—(1) There should be a thoroughly organised system of technical education, leading up from the primary and secondary schools to the technical school, and having, as its crown, the technical university, every stage of the system being in intimate contact with the next, so far as possible without overlapping, and the educational work must be carried out in the closest possible cooperation with the employer. (2) This system should be a national one; that is to say, the Board of Education should not only inspect and supervise the individual institutions, but should ensure proper coordination; extend by law the leaving age for children, when and where necessary; enlist by all available means the cooperation of employers, and introduce a uniform system of examinations and degrees; and it should, from its exalted position, watch the working of the system, comparing it with that of other nations, and generally employing and developing the powerful weapon of technical education in the interests of the industries and the progress of the nation as a whole.

I take it as being agreed upon that the scientific leaders of industry require much more complete training than the rank and file of the industrial army, chiefly the additional training of strict scientific accuracy, of research, and originality. That in view of the numbers to be dealt with in both sections, respectively, there must be a large number of schools for the rank and file in close contact with local industries, and a small number of colleges for the officers. This means decentralisation in the case of lower technical schools, and centralisation for the technical universities. I have dealt in a previous paper with the Prussian technical universities (Nature, April 15, 1909, vol. lxxx., p. 205). How does Prussia attend to the needs of the rank and file? There were, in 1909, 23 national engineering schools, 24 national building schools, 7 national art and artisan schools, and [illegible] State-supported municipal technical schools of different kinds, including 6 textile schools and 7 higher textile schools. Most of these institutions do no evening work, and the students pass through systematic courses extending over several years. During this time they are not in contact with practice, except that the building students, making the best of climatic conditions, frequently work in summer and study during the winter months, and that other students sometimes do practical work during the summer vacations. Generally speaking, however, the students are not in contact with practice. I also incline to the view that there has been too much centralisation in this branch of technical education. As a consequence, there is a lack of intimate contact with local industries, and insufficient amalgamation of theory and practice. Furthermore, most of these schools do not really train skilled workmen and artisans, but what may be termed the non-commissioned officers of the industrial army. The courses are somewhat expensive, and, through the almost complete absence of a system of scholarships, they cater more for the middle classes than the working classes. Another defect, and a very serious one in my opinion, is the absence of systematic cooperation between these schools and the technical universities, whereby students of exceptional ability would be sent up to the latter.

In England the corresponding educational work is overwhelmingly carried on in evening classes, and, though in principle I am in the fullest agreement with those who object to all evening work and wish it transferred to the day, I cannot but admire the magnificent work now done under the course system in evening schools, and the most valuable and unique features of the same. What are they? It is, first and foremost, the intimate and continued contact of the students with practice which infuses their daily work with heightened interest derived from the application of their studies, and, on the other hand, reacts on the teacher and makes the courses, though they must remain theoretical, yet of a thoroughly practical nature and best suited to the needs of the local industries. It is, secondly, the complete elimination of the bitter disappointment which many day students, in proud possession of first-class certificates and diplomas, now experience when they find that they cannot secure any suitable employment. This "sandwich" or "half-time" system, which we so justly condemn when it is applied to primary education, is, in my view, the ideal system for the training of the industrial rank and file. I am therefore of opinion that those who desire to see the present evening work abolished, and the day schools developed on the German lines, are very ill-advised. Whatever we do, let us retain the great feature of the English principle, that is, the concurrent training in factory and school. Let us make the present evening courses much more efficient by establishing proper cooperation with the employers, and by reducing the hours of labour, so that it becomes possible gradually to shift the centre of gravity from the evening to the day. Thus we shall obtain all we are striving for without losing the great features I have emphasised, as well as the truly democratic spirit of the present system and its hold on the masses of the population. In advocating progress in this direction, we shall work in harmony with the enlightened employer and with the trades unions, and we have on our side the powerful influence of the social reformer as expressed in the reports of the Poor Law Commission. Indeed, the President of the Board of Education, in a reply to a deputation from the Trades Union Congress only a few days ago, indicated that legislation on these lines—including the raising of the leaving age and technical classes during daytime in cooperation with employers—is under consideration, and it remains to us to insist that the Bill shall be speedily produced and placed on the Statute book in a shape which conforms with our views.

We must convince employers that the developments which are shortly to take place are first and foremost in their own interests, and we should insist that definite provision be made in the promised Bill for an advisory board to be attached to each technical school, such board to have subcommittees representative of the chief local industries and trades; but there is a further, and, if possible, more important point to be considered. The technical school, as thus firmly established by law, must not be an isolated unit in our educational system, but it must be a link in a complete chain. It must join at the bottom with the secondary school, especially with the technical secondary laid down as a desideratum in our resolutions of last year, and it should lead up to the technical university above. It is the need for an organic connection of the ordinary work with the highest form of technical education on which I wish to lay particular stress. No better form can I imagine for this link than that of a comprehensive and national scheme of maintenance scholarships, by means of which the students of exceptional ability and enthusiasm are lifted up and trained to be the scientific leaders and original workers.

What would be the cost to the nation of such a scheme? Assuming 250 national scholarships to be awarded annually, tenable for four years, value 75*l.* per annum and free tuition, we arrive at the trifling expense for this highly productive scheme of 75,000*l.*, about one-thousandth part of what we spend every year on unproductive armaments. Surely, looking at it from a business point of view, no sounder investment could be imagined, and there is little doubt that if the nation would institute this magnificent

plan, the municipalities, the wealthy industrial and professional societies, and private benefactors, would come forward to expand it and make it more fruitful.

Thus we have arrived at the technical university, and in passing I will only remark that up to this level of technical education there is every likelihood of Prussia having shortly to learn a great deal from England. The aspect changes completely, however, when we contemplate the higher branches. In the latter, in Prussia we find thorough organisation and efficiency; in England we find chaos and waste of energy and money. The explanation is simple: the Prussian technical high schools are national institutions, just sufficient in number for the needs of the whole nation so as to allow of intense specialisation in all branches. The many English institutions attempting higher technical work were founded by private persons, guilds, societies, municipalities, and whosoever liked to distinguish himself in this direction. The national Government has made the sad mistake of generously supporting all these well-meant efforts, so far with little regard, apparently, to the effect of the one on the other. The borough, and even the county, is far too small a feeding area for a modern technical university, with its large staff of specialised experts in all branches, training original workers, carrying out industrial research, and generally permeating the industries with progressive ideas.

How will it be possible to bring about the formation of such efficient universities? Without doubt, the difficulties of this task are formidable, yet they can be surmounted by a strong Minister of Education, and the accomplishment will earn for him the gratitude of generations.

As an introduction to a discussion on this particular question, one or two suggestions may perhaps be acceptable. Needless to say, decisive steps in the direction indicated must be preceded by an exhaustive inquiry of a Royal Commission into the whole subject. One of the aims of the commission would be to discover a ready means of correlating the work of universities with that of other institutions which, as yet, is non-existent. It may be found desirable that all Exchequer grants for educational purposes, without exception, should pass through the Board of Education in such a manner that the grant becomes an effective weapon of organisation. Another important point to be settled is the number of technical universities needed, and their respective feeding areas. I believe that three for England and Wales, one for Scotland, and one for Ireland, or even less, would be found to be sufficient for many years to come. Finally, the most difficult point as to the method of procedure will have to be decided.

It appears not unlikely that, as a result of the inquiry of the special Royal Commission appointed last year, such amalgamation may soon be brought about so far as London is concerned, and an early extension of the principle to the provinces would then be within the range of probability. The leading institutions at present existing in each university area decided upon would form the constituent colleges; they might have the first and second years' courses in common, which, of necessity, would be generally scientific and educational in character, including such subjects as national economy, industrial history, industrial legislation, patent laws, &c., but the higher branches would be distributed according to the nature of the institutions and the industrial activities of the districts. Thus the desired concentration of effort and of students would be secured, and, by a process of natural development, the formation of a large staff of specialists in each branch working in intimate contact with their respective industries.

Higher technical education in England, if developed on such lines, would have adopted only one important point from the Prussian system, that is, organisation on a national basis, a point which, in my opinion, is indispensable to success. Other and less important points of similarity, such as the uniform system of examinations and of legally protected degrees, would come as a natural consequence. In more than one regard, of profound importance, however, the English would be far in advance of any existing system, so far as my knowledge goes; first, in its democratic principle, culminating in the character of its students, who, gathered by a process of sifting and selection, represent the genius of the rising generation in whatever sphere it may have been born—a class, not of aristocratic idlers, but of enthusiastic workers. This ideal we shall approach only gradually, yet it is in sight, and we may accelerate its coming by advocating that the fees of the new universities for all except the scholarship students shall not be kept low, but shall be, at any rate, in proportion to the cost of such institutions. The scholarship students will thus predominate more and more, which makes it possible at the same time to adjust the number of highly trained men to the needs of the industries. We shall thus avoid excessive supply, which is a social and economic danger, and is a blame often, and not unjustly, attached to the German high schools; and, finally, the close cooperation of the new universities with the respective industries would be a unique feature. It would be maintained, not only, as in Germany, through the professors and lecturers, but through their advisory boards, and, what is perhaps most important, through the students themselves, who have been in contact with practice, not merely for a short term of pupilage like the average German student, but who have passed "through the mill."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. ARTHUR WILLEY, F.R.S., director of the natural history museum at Colombo, has been appointed to the chair of zoology at McGill University, Montreal.

ON Friday, April 22, the Education Bill restricting half-time employment will be considered by the House of Commons if the Government leave the day free. It is hoped that time will be found for the consideration of this important and long-delayed reform in the present Parliament.

THE London Inter-collegiate Scholarships Board announces that an examination will be held on May 10 for twenty entrance scholarships and exhibitions of an aggregate total value of about 1500*l*., open to men and women, and tenable in the faculties of arts, science, and engineering of University College, King's College, and the East London College. Candidates must have passed the matriculation examination of the University of London, or an examination accepted in lieu thereof, or be able to furnish some evidence of having had a sound general education. Full particulars and entry forms may be obtained from the secretary of the Board, Mr. Alfred E. G. Attoe, University College, Gower Street, London, W.C.

THE Department of Agriculture and Technical Instruction for Ireland will in August next award not more than six industrial scholarships to persons engaged in industries, such as the woollen, linen, leather, and tanning industries. The object of these scholarships is to enable selected persons, who must already have been engaged in one of the higher branches of the industry, to take a full course of instruction in an institution providing special courses of an approved character, with the view of training them for the management of such an industry. The scholarships will be tenable at some higher institution, to be approved by the Department, in which the industry, and the principles underlying it, are taught. They will be of the value of 80*l*. each, and may be renewed for a second or a third year at the discretion of the Department. The Department will also award not more than six commercial scholarships to young men having a sound general education and some commercial experience. The object is to afford facilities for the holders to obtain training in some higher institution, approved by the Department, with the view of their employment as teachers of commercial subjects in Ireland. The commercial scholarships are of the value of 100*l*. each, and are tenable for two years.

On the occasion of the opening of the Carnegie Science Building at Acadia University, Wolfville, N.S., last October, Prof. H. A. Bumstead, of Yale University, delivered an address on the functions of a university laboratory. A reprint of the address is published in *Science* of March 11. After dealing with scientific studies from the disciplinary and ethical points of view, and urging that they are peculiarly adapted to the purpose of leading young men into the paths of careful, sensible, fearless, original thinking, he pointed out that laboratories have a much higher educational function to perform than merely to produce engineers or technical chemists or practising physicians; but Prof. Bumstead insisted most on the laboratory being a place for research. True research, real scientific pioneering, does not strongly appeal to the general public; its applications may be remote, it shows no immediate profit, its achievements are not spectacular, and are often too technical to be understood fully by any but experts. Thus it comes about that it must be encouraged and supported by the more enlightened fraction of mankind, and the chief agency through which this support may be given is the university or college. No other institution has been devised or seems likely to be invented which can perform the task so well. Research is not altogether a business, but an art as well, and that while organisation and division of labour may be the life of business, it is not the soul of art. To produce the highest results in scientific research there must be individuality and freedom, and there is room for far more individuality in a university laboratory than in any special research laboratory which has hitherto been established. Engaging in research is the best way and the only certain way for a teacher to keep himself alive intellectually and to retain his spirit and enthusiasm to the end. Even if the college he serves regards teaching and not research as its chief business, even then a professor must be given a reasonable amount of time and reasonable opportunities for research in order that he may keep his intellectual health, just as he is given time for physical exercise in order that he may maintain his bodily health.

When we directed attention about two years ago to the second part of the first volume of the Journal of the Municipal School of Technology, Manchester, a volume of 130 pages of reprints of papers written by members of the staff of the school during the years 1903–7, we expressed doubt as to whether the output of research from the school was adequate in view of the fact that the staff numbered 100. The appearance of vol. ii. of the journal, which contains nearly 300 pages, and covers the papers published by the staff during the year 1908 only, removes all possibility of doubt on this score, and shows conclusively that the educational authorities of Manchester are alive to the importance of creating an atmosphere of investigation throughout the school. Of the sixteen papers reprinted in the second volume, three deal with pure chemistry, and form part of the series on the relations between outer form and chemical structure with which Prof. Pope's name is so closely associated; six deal with cotton, the staple trade of Manchester; five deal with electrical engineering and its teaching; one with mechanical and one with sanitary engineering. This list shows that the most important departments are all permeated by the desire to advance the subject with which they deal, and we may hope for a long succession of volumes from the school like the one before us. In the note referred to above regret was expressed that there seemed to be little evidence that the larger polytechnics in and about London, and the technical schools in the great towns of the provinces, *e.g.* Birmingham, Glasgow, and Belfast, adequately appreciated the importance of making themselves, above everything, centres of research for the solution of those problems which the highly specialised processes carried out in each district are constantly encountering. Far too many of the institutions of this type distributed over the country are content to record the thousands who have been taught elementary science within their walls, when the record is but one of their failure to do anything more than fill in some of the most conspicuous gaps in the education of those who come to them from the primary or secondary schools of the district. It is necessary to urge such schools to leave elementary-school work to the elementary schools, and to make themselves efficient as centres for the higher work of teaching and research in the subjects which bear on the principal trades of the district. May the example of Manchester spur them on to a better use of their opportunities.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, April 5.—Prof. E. A. Minchin, vice-president, in the chair.—R. H. **Whitehouse**: The caudal fin of the Teleostomi. The paper dealt with the structure of the caudal fin in about fifty different species of fishes, mostly Teleostei, and representative of nearly all the sub-groups. After each sub-group a few general remarks were added, and these were followed by a short summary of results dealing with definitions and the taxonomic value of the caudal fin.—T. M. S. **English**: Some notes on Tasmanian frogs. The paper was based on observations made during rather more than two years' residence in Tasmania.

PARIS.

Academy of Sciences, April 4.—M. Émile Picard in the chair.—The president announced the death of A. Agassiz, foreign associate.—Wilfred **de Fonvielle**: The theory of Fontenelle relating to the constitution of comets. The author maintains the possibility of Fontenelle's view that the comet acts as a gaseous lens, and discusses Kepler's objections to this theory.—J. **Haag**: The spherical representation of certain families of Lamé.—René **Arnoux**: The longitudinal equilibrium and curvature of the carrying surfaces of aëroplanes. The effect of increasing the curvature of the supporting surfaces is to increase the power of support, but, at the same time, the resistance to translation is increased, and the longitudinal equilibrium becomes unstable.—A. **Votton** and H. **Mouton**: Havelock's relation between double refraction and the index of refraction. Havelock's formula has been verified experimentally by Skinner and McComb for the magnetic double refraction of eight liquids, and the authors have also verified it for nitrobenzene. This formula is based on the assumption that the field modifies the distribution, but it is also consistent with the hypothesis that there is an orientation of the anisotropic molecules.—F. **Croze**: The prolongation of the band spectrum of nitrogen in the extreme red and the infra-red.—V. **Crémieu**: A systematic error limiting the precision of the Cavendish experiment. A new method for the study of gravitation. The error is caused by a supplementary couple resulting from the bending of the supporting wire. A method is outlined by which this error can be eliminated.—C. **Chéneveau**: The specific refractive powers or optical constants of dissolved substances in very dilute solution. An interference method was used, and the error due to differences of temperature in the two vessels discovered and eliminated. Ionisation does not appear to have any sensible influence on the refractive power of a dissolved substance in solutions of which the concentrations are more than 0·5 gram per litre.—Louis **Wertenstein**: The paths of radio-active projections.—A. **Besson** and L. **Fournier**: The reduction of the chlorides of boron and arsenic by hydrogen under the influence of the silent discharge. Arsenic trichloride is reduced, and a substance is formed the composition of which corresponds to $As_{11}Cl$; this may possibly be a mixture of arsenic and a lower chloride than $AsCl_3$. No subchloride of boron could be obtained.—J. **Bougault**: The acid-alcohols of conifers. Juniperic and sabinic acids. Juniperic acid was proved to be $CH_2(OH).(CH_2)_{14}.CO_2H$, and sabinic acid

$$CH_2(OH).(CH_2)_{10}.CO_2H.$$

Thapsic acid, extracted by F. Canzoneri from the resin of *Thapsia Garganica*, was shown to be identical with juniperic acid.—Marcel **Delépine**: Some organic compounds spontaneously oxidisable with phosphorescence. Eleven substances are described which possess this property, all having in common the group (S=C—O—).—E. **Voisenet**: The detection of hexamethylenetetramine

in musts and wines. The process is based on the fractional distillation of the acidified wine, followed by a colour test with albumen, hydrochloric acid, and nitrous acid. The latter is stated to be a specific test for formaldehyde.—P. **Vuillemin**: Materials for a rational classification of the *Fungi imperfecti*.—M. **Biéler-Chatelan**: A drainage effect.—H. **Bordier** and R. **Horand**: The action of the ultra-violet rays on trypanosomes. The action of the rays has been followed continuously under the microscope. The trypanosomes become rapidly granular, and their bodies, having the same refractive index as the surrounding medium, cannot be seen.—M. **Lecoq**: The toxic power of metalloidal arsenic. This is much less than that of corresponding quantities of arsenious oxide.—Emm. **Pozzi-Escot**: A bird of the runner family, confined to the high summits of the Peruvian Andes.—Charles **Nicolle** and L. **Manceaux**: The experimental reproduction of the pustule of the East in the dog. The possibly canine origin of this disease.—F. **Diénert**: The search for fluorescent substances in mineral waters.

DIARY OF SOCIETIES.

THURSDAY, APRIL 14.

ROYAL SOCIETY, at 4.30.—On the Viscous Flow in Metals and Allied Phenomena: E. N. da C. Andrade.—The Refraction and Dispersion of Argon, and Redeterminations of the Dispersion of Helium, Neon, Krypton and Xenon: C. and M. Cuthbertson.—The Action of the Radiation from Radium Bromide upon the Skin of the Ear of the Rabbit: T. O. W. Barratt.—A Physiological Effect of an Alternating Magnetic Field: Prof. S. P. Thompson, F.R.S.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

FRIDAY, APRIL 15.

ROYAL INSTITUTION, at 9.—The Chemical Significance of Crystal Structure: Prof. W. J. Pope, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Further discussion*: Compounding and Superheating in Horwich Locomotives: G. Hughes.—*Probable Paper*: A Research on the Hardening of Carbon and Low-tungsten Tool-steels: S. N. Brayshaw.

SATURDAY, APRIL 16.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer.

MONDAY, APRIL 18.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Glacier Exploration in the Eastern Karakoram: Dr. T. G. Longstaff.

VICTORIA INSTITUTE, at 4.30.—Plato's Theory of Public Education in Relation to the Christian Doctrine of Human Nature: Rev. H. J. R. Marston.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Brick-making: Dr. A. B. Searle.

TUESDAY, APRIL 19.

ROYAL INSTITUTION, at 3.—The Modern Development of the Problem of Alcoholic Fermentation: Dr. A. Harden, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

ZOOLOGICAL SOCIETY, at 8.30.—Notes on the Photophores of Decapod Crustacea: Stanley Kemp.—On the Varieties of *Mus rattus* in Egypt, with General Notes on the Species having reference to Variation and Heredity: J. Lewis Bonhote.—On an Example of Posterior Dichotomy in an Aylesbury Duckling: G. E. Bullen.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Use of Reinforced Concrete on the Wabash Railroad, U.S.A.: E. R. Matthews and A. O. Cunningham.

WEDNESDAY, APRIL 20.

ROYAL MICROSCOPICAL SOCIETY, at 8.—(1) Critical Microscopy; (2) What did our Forefathers see in a Microscope? E. M. Nelson.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Line Squalls and Associated Phenomena: R. G. K. Lempfert and R. Corless.—Daily Rainfall at the Royal Observatory, Greenwich, 1841–1903: W. C. Nash.

ROYAL SOCIETY OF ARTS, at 8.—Industrial England in 1754 (the Date of the Foundation of the Society): Sir H. Trueman Wood.

THURSDAY, APRIL 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Incidence of Light upon a Transparent Sphere of Dimensions comparable with the Wave-length: Lord Rayleigh, O.M., F.R.S.—On the Improbability of a Random Distribution of the Stars in Space: Prof. Karl Pearson, F.R.S.—The Total Ionisation produced in Different Gases by the Kathode Rays ejected by X-Rays: Dr. R. D. Kleeman.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

CONCRETE INSTITUTE, at 8.—The Effect of Sewage and Sewage Gases on Portland Cement Concrete: S. H. Chambers.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Hydro-electric Installations of Sweden: A. V. Clayton.

ROYAL SOCIETY OF ARTS, at 4.30.—The Arts and Crafts of Tibet, and the Eastern Himalayas: J. Claude White.

ROYAL GEOGRAPHICAL SOCIETY, at 4.30.—Dewponds: E. A. Martin.

LINNEAN SOCIETY, at 8.—The Seedling and Adult Anatomy of *Welwitschia mirabilis*: Miss M. G. Sykes.—Anthomyidæ auf den Seychellen gesammelt: Prof. P. Stein.—The Dermaptera of the Seychelles: Dr. Malcolm Burr.—The Pteropoda and Heteropoda collected by the Percy Sladen Trust Expedition in the Indian Ocean: Dr. J. J. Tesch.—Die Pilzmücken Fauna der Seychellen: Dr. G. Enderlein.

FRIDAY, APRIL 22.

ROYAL INSTITUTION, at 9.—The Telegraphy of Photographs, Wireless and by Wire: T. Thorne Baker.

PHYSICAL SOCIETY, at 5.—Further Tests of Brittle Materials under Combined Stress: W. A. Scoble.—The Magnetic Balance of Curie and Cheneveau: C. Cheneveau with A. C. Jolley.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The History and Present Method of Quay-wall Construction at the Port of Rotterdam: H. C. A. Thieme.

SATURDAY, APRIL 23.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer.

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THURSDAY, APRIL 21, 1910.

THE CORRESPONDENCE OF OLBERS AND GAUSS.

Wilhelm Olbers, sein Leben und seine Werke. Im Auftrage der Nachkommen herausgegeben von Dr. C. Schilling. Zweiter Band, Briefwechsel zwischen Olbers und Gauss, Zweite Abtheilung. Pp. vi+758. (Berlin: J. Springer, 1909.) Price 16 marks.

TEN years have elapsed since the first part of this volume appeared (NATURE, vol. lxi., p. 486), the editor having been prevented by other occupations from completing his work, until he secured the co-operation of Dr. Kramer. The present part (or rather volume) comprises the years from 1820 to the death of Olbers in 1840. Although it forms part of a publication intended to keep alive the memory of Olbers, the real hero of this volume is Gauss, not only because he was a greater man than his correspondent, but also because the scientific work of Olbers was almost finished before 1820. All the same, the volume serves to complete the picture of the charming personality of Olbers with which previously published letters had supplied us, while it almost forms a diary of the scientific work of Gauss during the years 1820–40.

At the beginning of 1820 the new transit circle by Reichenbach had just been mounted at the Göttingen Observatory, and Gauss was busy studying what was practically a new form of instrument. Though he was very fond of observing, the Göttingen Observatory did not accomplish as much as might have been expected, considering the devotion of the director to astronomy and the fine instruments at his disposal. This was partly caused by the various other pieces of work in practical science which occupied so much of his time, partly by his never having an assistant until the death of Harding (in 1834), who held a rather anomalous position. Geodetic work soon came to occupy most of Gauss's time. The continuation of the Danish survey southward through Hanover was finally decided on in 1820, and the work in the field was carried out during the summers of the next five years, most of it by Gauss himself, who, both on this and on the computation of the results, spent a vast amount of time. One cannot help regretting that so great a mathematician should have been obliged or found it necessary to do so much routine work himself instead of merely supervising its execution by others. No doubt this work gave rise to several theoretical investigations of great value, and occasioned the invention of the heliograph by Gauss, but these results would have been produced equally well by his brain if the fatiguing work in the field and the arithmetical drudgery at home had been done for him. Attempts were repeatedly made at Berlin, especially in 1824, to get a post created for Gauss in connection with the Academy of Sciences, but they were never successful. At Berlin he would have been relieved of all teaching work, which he greatly disliked, and his time would have been almost altogether his own. The work on the survey continued to drag on; the present volume gives full details about the various stages of it, but everything of permanent interest has already been given in excerpts from these letters in Gauss's collected works.

During the second half of the period in question Gauss devoted himself chiefly to researches on terrestrial magnetism, and continued to keep Olbers posted on the progress of this work. Naturally the electro-magnetic telegraph which was established in 1833 between the observatory, the Johannisthurm, and the physical laboratory, a distance of several thousand yards, is described with pride and in full anticipation of the great possibilities of the invention. The cooperation of Gauss and Weber in the magnetic work came to an end in 1837, when Weber, as one of the seven professors who had protested against the King's violation of the constitution, had to leave Göttingen. In his letters, Gauss expresses himself with great caution about this unpleasant affair, because, as he says himself, it was not at all unlikely that letters were tampered with while they were on the way.

Though Olbers in his letters had no great investigations to describe to his friend, he had always something of interest to say about the current scientific events of the day. It is interesting to see him occasionally give his opinion about some of his contemporaries. Thus he considered W. Herschel "a good mathematical head, but too much wanting as regards scientific education, though his, so to say, natural mathematics generally guided him in the right direction." As to Schröter, Olbers thought that though Mädler had spoken rather too severely of him, he certainly had very exaggerated ideas as to what his telescopes could show, and believed that no one but Herschel could verify what he himself saw or imagined he saw.

As a sort of running commentary on the progress of astronomy, Olbers's letters are of great interest, but their value to most readers would have been much increased if the editors had been more liberal with footnotes giving references to astronomical literature. Thus, when Gauss sets forth his grave doubts as to the alleged fraud of d'Angos, it should have been stated that Gauss much later wrote a short paper on this subject, which was printed after his death; also that the researches of d'Arrest and Gyldén have rendered it at least extremely doubtful whether any fraud had been committed. Similarly, when Olbers assumes it to have been proved that Hell falsified his observations of the transit of Venus, it should have been pointed out that Newcomb most thoroughly established Hell's innocence. The nebula mentioned on p. 43 is N.G.C. 7293, and the mysterious nebula of Cacciatore (p. 461) is N.G.C. 6541, as to which J. Herschel showed long ago that Cacciatore had simply made a blunder in identifying a star (Gen. Cat., p. 37).

This correspondence fills two stout volumes in large octavo, 1500 pages in all. Is it really worth while to print every single word that a great man puts on paper? It is natural that a man should tell his intimate friend at some length that his wife and children have measles, or repeatedly give vent to his sorrow and indignation at the conduct of a good-for-nothing

son; but it goes without saying that he does not want all this printed. A judicious selection from these 734 letters would have been very much more valuable than this unsifted mass of important and unimportant matter. There is an excellent index, which will be of great use to a reader desirous of referring to any particular subject. In an appendix are given some letters about the negotiations to get Gauss an appointment at Berlin, and three very interesting letters from Bessel to Olbers from the year 1812, which have only recently been found. J. L. E. D.

COLONIAL FRUIT-GROWING.

Fruit-ranching in British Columbia. By J. T. Bealby. Pp. viii+196. (London: A. and C. Black, 1909.) Price 3*s*. 6*d*. net.

THIS is a practical work on the subject of fruit-growing in British Columbia, and we recommend it to any who have the intention of emigrating for the purpose of engaging in this healthful and interesting pursuit. But not to these alone, for the style in which it is written is sufficiently good to make the reading agreeable to the general public. It sets forth in plain but picturesque language the reasons that led the rancher to select British Columbia for the scene of his operations; it describes his journey out, relates the difficulties the new settler had to overcome, and proceeds to describe the measure of success that soon attended his labours.

This success enabled him, not only to win prizes for fruit at exhibitions in British Columbia and in the United States, but also to send excellent apples to the Royal Horticultural Society's shows in London, and gain for them the Society's gold medal!

The figures relating to the crops obtainable per acre in British Columbia are almost bewildering to the cultivator in this country, who can never be certain, even of a moderate return, until the danger of spring frosts is past at the end of May. The difference is explained by the sunnier skies, freedom from violent winds and storms, and the presence of a most fertile soil. The allurements these things offer are only to those who are content to undertake the hard work inseparable from colonisation. Unless the "tender-foot" possesses a sufficient capital to enable him to purchase an estate already planted, he must commence by clearing away the trees and under-shrub from his plot, and in this and all other work he must improvise ways and means for carrying out the details which are simple enough in a more thickly populated country, but very difficult in parts of a colony in the first stages of development.

In these matters the reader will find much interesting information in Mr. Bealby's work. He will realise how important it is that the work of preparing the ground shall be done in a thorough manner, and that careful consideration shall be given to the planting of suitable trees. The settler has to take into account the kinds of fruit most likely to yield profitable returns, and having decided thus far he must select the best varieties of each kind. He must study his market, the means that exist for sending the fruits to market, and the length of time they will be on transit. The advice given on such matters as these is perfectly sound, and therefore calculated to assist settlers very materially, provided that instead of slavishly following them in detail they wisely modify them to suit best their own circumstances.

Mr. Bealby probably underestimates the cost of preparing the land, but this may be expected to vary in different districts, and he appears to place too much importance upon the fact that in the Kootenay and Okanagan districts the fruit plantations are more free from insect and fungal pests than in other localities. The explanation of this comparative immunity will probably be found in the newness of the land. Pests are seldom epidemic unless the host-plants are present in large numbers and so facilitate the spread of insects or fungi, but they usually appear when the cultivator has planted vast areas with the same kind of tree, or crowded them into a hot-house, as is the case with tomato and cucumber culture in our own country.

For this same reason, the best preventive is to plant thinly, allowing each tree as much isolation as can be spared with due regard to the yield per acre. It is satisfactory from this point of view to note that, so far as can be seen from the excellent illustrations contained in the book, it is not the practice to crowd the trees together in British Columbia. The trees depicted appear to have plenty of space around them, therefore they are exposed well on all their sides to the good influences of sunshine and air, which are conducive to healthy growth and a free cropping habit.

The evidence the book contains of the enormous help the settler in British Columbia may expect to receive from the Department of Agriculture and the British Columbia Fruit-Growers' Association should be an extra inducement to emigrants to select this country for their new home. We hope Mr. Bealby will return to the subject when he has gained further experience, for it has to be noted that he has only been engaged in the industry since 1907, a fact that may cause some to receive his recommendations with a certain amount of reserve, especially so far as they relate to yields, prices, and returns.

STEAM TABLES.

Tables and Diagrams of the Thermal Properties of Saturated and Superheated Steam. By L. S. Marks and H. N. Davis. Pp. 106. (London: Longmans, Green and Co., 1909.) Price 7*s*. 6*d*. net.

AN immense amount of painstaking work is represented by this little volume, which will, we think, be of undoubted use to all physicists and engineers who have to deal with problems involving the influence of heat upon water and steam. The two authors are connected respectively with the engineering and physical sides of the great American University of Harvard, and they have evidently formed a combination well suited for such an investigation as this. Until quite recently the only authoritative experiments over a considerable range of steam pressures and temperatures were those made by Regnault more than sixty years ago. We now have, however, the results of later experiments by Dieterici, Smith, Griffiths, Henning, Joly, Grindley, Peake,

Griessmann, Knoblauch, Thomas, and others. As the result of a careful weighing of these various experiments, the authors present the following formula connecting the total heat of one pound of dry saturated steam with its temperature (Fahrenheit):—

$$H = 1150{\cdot}3 + 0{\cdot}\text{[illegible]}45(t-212) - 0{\cdot}000550(t-212)^2.$$

The equation heretofore in use was $H = 1082 + 0{\cdot}305t$, which may also be put in the more directly comparable form of

$$H = 1147 + 0{\cdot}305(t-212).$$

It will be seen that there is a considerable difference in form between these two statements, although as one is of the second degree and the other of the first it is not easy to tell at sight by how much they would differ over the working range. The best way of comparing them is to set the figures in the old steam tables side by side with those in the new. This we have done for each increase of 50 lb. in the pressure. The figures in brackets are those of the old tables, as taken from such a standard book as Perry's "Steam Engine," and the remaining figures are those of the tables now published.

Pressure lb./in.²	Temperature ° F.	Sp. Vol. Cu. Ft. per lb.	Latent Heat	Total Heat	Entropy of Steam
1	101·83	333·0	1034·6	1104·4	1·9754
	(102)	*(334·2)*	*(1043)*	*(1113·0)*	*(1·987)*
50	281·0	8·51	923·5	1173·6	1·6581
	(280·8)	*(8·34)*	*(916·6)*	*(1167·6)*	*(1·649)*
100	327·8	4·429	888·0	1186·3	1·6020
	(327·6)	*(4·356)*	*(882·9)*	*(1151·8)*	*(1·596)*
150	358·5	3·012	863·2	1193·4	1·5692
	(358·2)	*(2·978)*	*(860·6)*	*(1191·2)*	*(1·566)*
200	381·9	2·290	843·2	1198·1	1·5456
	(381·6)	*(2·273)*	*(843·4)*	*(1198·3)*	*(1·545)*
250	401·1	1·850	826·3	1201·5	1·5276
	(401)	*(1·84)*	(—)	*(1204)*	*(1·529)*
300	417·5	1·551	811·3	1204·1	1·5129
	(417·5)	*(1·55)*	(—)	*(1208·9)*	*(1·515)*

It will be seen that at the ordinary steam-engine pressures of 150 to 250 lb./in.², there is very little difference between the two sets of figures, but that at lower pressures there is some variation, although in no case is it extreme. On the other hand, many calculations involve the estimation of differences of heat content, and in those cases it is essential to allow for any such corrections in the received steam tables. It is, therefore, hardly too much, perhaps, to suggest to those who have made important calculations with the old tables that they should recalculate their results on the basis of these later fiures.

Anyone reading carefully what the authors are able to say in support of the figures they give must concede that their researches have produced tables based on what is probably the most accurate data procurable at the present time. The theory of the steam engine will be considerably aided thereby, and one cannot but regret that there are no tables of equal accuracy applicable to the working fluid in the internal-combustion engine.

We regret that the authors should have presented the bulk of their results in the unscientific Fahrenheit scale. All who know the pitfalls which beset the paths of students will agree that, of them all, the most common and dangerous is the elusive "32" in the Fahrenheit scale. To have such a constant is never of any use, and its avoidance is the great merit of the centigrade scale. We should like to see these tables published throughout in the scientific temperature scale.

The book contains two sheets of very useful curves, which enable large numbers of simple problems to be solved by mere inspection. Among the illustrations given we quote the following:—

(*a*) A vessel of 4 cu. ft. capacity contains 0·2 lb. of water and 0·8 lb. steam. What is the pressure?

(*b*) What is the entropy of 1 lb. of steam at 100 lb. pressure and 450° F.?

(*c*) Steam of 140 lb. pressure, superheated 120° F., expands adiabatically with a ratio of expansion of 6. What are the pressure and quality at the end of expansion?

(*d*) Steam at 100 lb. pressure, superheated 60° F., expands in a nozzle to a pressure of 2 lb./in.². What is its final velocity?

(*e*) Steam in a throttling calorimeter with a pressure of 17 lb./in.², and a temperature of 265° F. The initial pressure of the steam was 100 lb./in.². What was its initial quality?

It will be admitted that the ready facility with which such problems can be solved by two simple sheets of curves is a great gain, and many workers in science and engineering will be thankful for this help.

H. E. WIMPERIS.

SNAKE VENOMS.

Snake Venoms. An Investigation of Venomous Snakes, with Special Reference to the Phenomena of their Venoms. By Dr. Hideyo Noguchi. Pp. xvii+315. (Washington: Carnegie Institution of Washington, 1909.)

IT is now forty years since Fayrer and Weir Mitchell laid the experimental foundations of knowledge of the chemical characters and physiological actions of snake venoms, their investigations being inspired largely by the desire to combat the high annual death rate from snake-bite. The study of snake venoms has, however, obtained a greater interest since the publication, about fifteen years ago, of observations demonstrating the possibility of producing a high degree of immunity in animals and proving the antidotal properties of the serum of the immunised animals. These phenomena in regard to snake venoms, having been brought into line with similar phenomena in regard to bacterial toxins especially, have been bound up with, and have contributed largely to, the elucidation of the problems of immunity which have in so many directions influenced modern medical thought. Hence there has arisen in regard to snake venoms a literature of high importance, and, from its involving scientific investigators in many countries, a literature necessarily extensive and dispersed.

As the author of this book states, there is at this time, in the English language, no single work which treats of the zoological, anatomical, physiological, and pathological characteristics of venomous snakes with special reference to the properties of their venoms. As something more than a mere summary of the position

of the present knowledge concerning snake venoms, Noguchi's publication merits high praise, and it possesses in addition a vitality which can belong to such a work only when its author has taken a living part in the researches by which this knowledge has been acquired.

It is impossible here to do more than indicate the scope of the book. The earlier sections deal especially with the morphology and geographical distribution of venomous snakes, and with the description of their poison apparatus. The toxic secretions, their physical and chemical properties, and the effects of various physical and chemical agents upon them are then discussed. A summary is given of the symptoms produced by snake-bite in man and by experimental poisoning in animals, and the intimate nature of these effects on the different systems is then taken up in detail. The last sections deal with the problems of immunity to venoms—artificial immunisation, the specificity and therapeutic value of antivenins, the interaction between venom and antivenin, natural immunity, and the treatment of snake-bite.

It may be pointed out that the logical sequence of the last chapters is marred by the somewhat irrelevant interpolation of sections on the effects of venom on cold-blooded animals, plants, &c., between the chapter on natural immunity and that on the treatment of snake-bite. We believe improvement would be obtained by considerable rearrangement of the order of the sections.

The book contains many excellent illustrations, especially of the different species of venomous snakes, their anatomical features, and the pathological changes induced in the tissues by venoms. Several of the illustrations are reproduced from Fayrer's classic work, but many are original. For a book so well illustrated, the binding, in the form we have seen it, is inadequate.

As being the most important practical outcome of the researches epitomised in this publication, the problems concerned with the treatment of snake-bite call for special mention. In regard to the nature of antidotism, Noguchi definitely adopts the view, first propounded, and supported by convincing proof, by Fraser, that this antidotism is not of the nature of a vital action, but of a chemical reaction, between the antivenin and the venom. This view has subsequently been adopted by Calmette, who at first insisted on its being a vital process, and also by Ehrlich in relation to the closely allied antidotism of pathogenic toxins by antitoxins. In its relation to venoms it has also received further support from experiments by Martin and Cherry, and by Stephens and Myers, respectively summarised in pp. 248 and 140 of Noguchi's book.

With respect to treatment, the author chiefly favours specific treatment by antivenins, and expresses the hope and expectation that sufficiently powerful antivenins may yet be produced to cure more severe cases of snake-bite than can yet be done. He emphasises the necessity, as Fraser had experimentally demonstrated, of using large quantities of antivenin, a general principle now being extended to the therapeutic use of antitoxins in disease. He places in a subordinate position all non-specific agents, such as permanganate of potash or chloride of gold, the antidotal effects of which he believes to be very restricted, but still of some value as being quickly and conveniently applicable.

We may further mention that the book contains a good workable bibliography. It is a book which will be of great service to future investigators.

THE EVOLUTION OF MAN'S STRUCTURE.

History of the Human Body. By Prof. H. H. Wilder. Pp. xii+573. (New York: Henry Holt and Company, 1909.) Price 3 dollars.

PROF. WILDER defines the twofold purpose of his book, as, "*first,* to present the results of modern anatomical and embryological research relative to the human structure in a form accessible to the general student, and, *secondly,* to furnish students of technical human anatomy with a basis upon which to rest their knowledge of details;" and there can be no doubt that, as the founder of a village newspaper would express it, he has "supplied a long felt want."

So much technical knowledge has to be acquired by the modern medical student in the brief span of time between matriculation and graduation that there is an ever-insistent tendency to curtail the preliminary scientific subjects in the medical curriculum. The effects of a scamped education in biology are becoming more manifest every year in the writings of anatomists and physiologists, when, as so often happens, the results of long and arduous researches are thrown away for the lack of a modicum of zoological or morphological knowledge.

Prof. Wilder's book, if placed in the hands of the medical student, will help him to bridge the gap between his biological and anatomical studies, and, in the later stages of his career, will help to save him from solecisms such as are being perpetrated far too frequently at the present time.

The wide scope of the work is indicated by the titles of its chapters, which deal with "the continuity of life," "the phylogenesis of vertebrates," "the ontogenesis of vertebrates," the integumentary, skeletal, muscular, digestive (and respiratory), vascular, urogenital, and nervous systems, the sense-organs, and "the ancestry of vertebrates," and an appendix on the classification of vertebrates.

The first chapter explains the fundamental principles implied in the terms phylogenesis and ontogenesis, which form the subjects of the second and third chapters respectively.

The account given in these three chapters (*a*) of the factors which played some part in the evolution of man, and (*b*) of the line of man's ancestry, is lucid, and, on the whole, satisfactory. The author has entirely failed, however, to realise and to set forth the immense importance which must be assigned to the Dipnoi in supplying evidence for explaining the evolution of the Amniota.

In chapters iii. to xi. (inclusive) the author has clearly stated the facts of comparative anatomy which throw light upon the morphology of the various systems of the human body, which I have already enumerated. These portions of the work are of considerable value, not only to the student of human

anatomy who wants to learn how the organs of man's body have come to assume their form and structure, but also to the zoologist, who will find in this book a concise statement of the light thrown upon the structure of vertebrates in general by the detailed study of the anatomy and development of one mammal.

The scope of the work is so wide that the reader cannot expect to find accuracy in every detail, or a freedom from time-worn and conventional errors; but, in his preface, "the writer craves the indulgence of those who have directed their special attention to any one of the subjects touched upon," and the impartial reviewer is bound to admit that the merits of the broad view of animal structure given in this book far outweigh its defects, which, on the whole, concern matters of detail only.

But when it is noted that in the second chapter Prof. Wilder properly insists that "the one line of development by which the Primates have become differentiated is in that of their central nervous system, and especially that of the cerebrum" (p. 41), the reader has a right to expect something more than the rather perfunctory account of this system, the influence of which has been paramount in making man what he is. Nor is it too much to expect that a zoologist, even if he has not "directed his special attention" to the question of the distribution of animals, should know that the monotremes do not "occur in New Zealand" (p. 33), and that Galeopithecus is not "found in Madagascar" (p. 37)!

In the final chapter a concise and impartial account is given of (*a*) the Annelid, (*b*) the Nemertean, (*c*) Gaskell's (though the name of its author is not mentioned), and (*d*) the Protochordate theories of the origin of vertebrates; and the author ends his interesting handbook with the quotation from Korschelt and Heider:—"The origin of vertebrates is lost in the obscurity of forms unknown to us.

G. E. S.

MAPS OF THE THAMES BASIN.

The Basin of the Thames. (Lettered and Unlettered.) (Edinburgh: W. and A. K. Johnston, Ltd., n.d.) Price 12*s.* each.

THIS publication consists of two maps, with and without names. The map containing names is well designed and should be of great value for schools. Contours are shown at 800, 600, 400, 300, 200, and 100 feet, and the areas of equal elevation are distinguished by shades of brown. The rivers are printed in blue, and stand out distinctly from the light brown tints. The names have been carefully selected, only initial letters being shown for towns, while physical names have been printed in a clear but subordinate type. These have followed the lines suggested in a recent map prepared by the Royal Geographical Society.

Local names, such as the New Forest, the Chilterns, the North and South Downs, have been necessarily retained, but to these have been added other names, not so generally well known, but descriptive of physical features. Such are the "Forest Ridges" of Sussex, Battle Ridge, the Western Downs, the Plain of Selsey, &c. It is to be hoped that these names, which are now generally accepted as being most suitable, will be used in all future maps, as a reasonable uniformity of nomenclature will avoid much confusion in teaching.

Railways, British and Roman roads, and the sites of Roman towns are shown in red. A most instructive lesson will be possible by the use of this map on the difference between ancient and modern lines of communication, and the sites chosen for Roman and modern towns. The map shows clearly that the Roman roads largely followed ridges and avoided river valleys, or, at any rate, kept along the edge of high ground. The Fosse Way, on the eastern margin of the Cotteswold Hills, and the Icknield Way, on the northern slope of the Chilterns, are excellent examples. Most of the Roman towns were situated on higher ground, away from the forests of the valleys, and in positions suited for defence.

The companion map, with no names except initial letters of towns, is disappointing. It was probably essential, for reasons of expense, to keep the representation the same as on the named map, but we feel that it might have been made much more effective if all the contours had been shown from 100 feet to 800 feet, and if the areas they enclose had been marked by clearly defined brown lines. The omission of the 500 feet and 700 feet contour lines means that steep escarpments, such as the southern front of the North Downs, fail to stand out clearly; and the higher valleys, such as those of the Chilterns, are only distinguishable by a close examination of the map. For a map intended for physical teaching the shapes of hill regions are of the first importance, and these need presentation in sufficient detail to give some clue, in connection, of course, with geological maps, to their formation.

It is to be regretted that no county divisions have been placed on the named map. A dotted line, sufficient for reference, would not have spoilt the clearness of the representation and would have been welcome to many teachers.

County boundaries, as studied from political maps, have certainly played too important a part in past teaching, but the regions which they define cannot be ignored in any systematic study of the regional geography of England or in that of local geography.

EARLY VIEWS ON INSECT LIFE.

Experiments on the Generation of Insects. By Francesco Redi, of Arezzo. Translated from the Italian Edition of 1688 by Mab Bigelow. Pp. 160. Portrait, facsimile of original title-page (1768), and 29 plates, besides illustrations in the text. (Chicago: Open Court Publishing Co.; London: Kegan Paul and Co., Ltd., 1909.) Price 2 dollars.

IN the early days of modern science much pioneer work had to be done in clearing away all manner of crude notions and legends, partly based on ideas and faulty explanations of facts or fables handed down from classical times, and partly on popular notions of later date. More than any writer of his period, Redi,

physician to the Court of Florence, and also a poet of considerable eminence, set himself to refute the old doctrine of spontaneous generation, and was mainly instrumental in proving that maggots, &c., did not arise spontaneously in the surroundings where they are met with, but originate from eggs deposited by the parent insect. In fact, Redi accomplished a similar service to science to that performed by Darwin and his coadjutors in our own time, when they gave the death-blow to the analogous doctrine of special creation, though, in the latter case, the task was much more difficult, depending rather on logical inference from facts than on actual experimental demonstration.

We are glad to welcome a translation of one of Redi's most important works, his "Esperienze intorno alla Generazione degl' Insetti," which attracted much notice at the period, and went through many editions in Italian and Latin between 1668 and 1688, and was reprinted frequently afterwards in his collected works.

After setting forth various classical theories of the origin of life on the earth, Redi continues:—

"Although content to be corrected by anyone wiser than myself, if I should make erroneous statements, I shall express my belief that the Earth, after having brought forth the first plants and animals at the beginning, by order of the Supreme and Omnipotent Creator, has never since produced any other kind of plants or animals, either perfect or imperfect; and everything which we know in past or present times that she has produced, came solely from the true seeds of the plants and animals themselves, which thus, through means of their own, preserve their species. And although it be a matter of daily observation that infinite numbers of worms are produced in dead bodies and decayed plants, I feel, I say, inclined to believe that these worms are all generated by insemination, and that the putrefied matter in which they are found has no other office than that of serving as a place, or suitable nest, where animals deposit their eggs at the breeding season, and in which they also find nourishment; otherwise, I assert that nothing is ever generated therein."

In proof of these statements, Redi proceeds to describe the breeding of flies from maggots found in dead animals, dung, fruit, &c. He also discusses the question of the bees in the carcase of Samson's lion, and thinks that they made their hive in the dried skeleton; an explanation which is perhaps not quite impossible, though the general view nowadays is that in this (as certainly in some other cases where bees are supposed to have been generated from dead carcases) the insects were not bees, but flies (*Eristalis tenax*), which were mistaken for them.

In a similar manner, Redi discusses the origin of wasps and scorpions; the effect of the sting of the latter; the cannibalism of lions; the habits of spiders; the breeding of frogs, and the tenacity of life in Mantis. He was, however, puzzled by galls, the insects from which are very difficult to rear; and was much perplexed about their origin. The last portion of the book discusses lice and other animal parasites. The illustrations of these and other animals are excellent, especially considering the period at which they were produced.

OUR BOOK SHELF.

(1) *Smithsonian Mathematical Tables. Hyperbolic Functions.* Prepared by G. F. Becker and C. E. Van Orstrand. Pp. li+321. (Washington: Smithsonian Institution, 1909.)

(2) *Tafeln für numerisches Rechnen mit Maschinen.* Herausgegeben von O. Lohse. Pp. vi+123. (Leipzig: W. Engelmann, 1909.) Price 12 marks.

(1) The increasing importance of hyperbolic functions in several branches of science and technology has led the Smithsonian Institution to furnish the computer with a more complete set of tables of these functions than was previously available. In the handsome volume before us are printed the natural values to five decimal places of the hyperbolic sine, cosine, tangent, and cotangent of u expressed in radians. The argument u advances by ten-thousandths from 0 to 0·1, by thousandths from 0·1 to 3·0, and by hundredths from 3·0 to 6·0. The logarithms of the above values are also given in separate tables. In order to facilitate interpolation the first derivatives of the functions multiplied by the tabular interval are tabulated in units of the last decimal place. To meet the rare cases in which higher values than six radians occur in calculations, some very high values of exponential $\pm u$ are appended to the seven-place tables of the exponential and its logarithm which are printed later on in the volume. To aid the computation of hyperbolic functions of complex variables, such as $\sinh(u \pm iv)$, the values of the circular functions $\sin u$ and $\cos u$, and of their logarithms to five decimal places, are provided with u expressed in radians. Tables are also provided of the gudermannian of u to seven places in radians, and also in degrees, minutes, and seconds. A few supplementary tables are printed for the convenience of the computer, one of which gives the natural logarithms of numbers from 1 to 1000, and another provides for the conversion of radians into angular measure and *vice versa.*

In preparing this volume a good deal of independent computation has been necessary in order to attain completeness and accuracy. In the introduction there is a useful compendium of formulas and integrals involving hyperbolic functions.

(2) Prof. Lohse, of the Astrophysical Observatory, Potsdam, has published these tables of reciprocals in order to simplify and extend the use of calculating machines in scientific computations. These machines deal readily with addition and multiplication, but in order to grapple with division it becomes necessary to take first the reciprocal of the divisor and then to multiply, *e.g.* to exhibit $n \div 1·759$ as $n \times 0·5685$. In this volume we have provided for us five-place values of the reciprocals of the natural numbers from 1 to 5000, and of the reciprocals of the trigonometrical functions of angles from 0° to 90° for every hundredth of a degree. Appended to the above are a few shorter tables, the most important of which is one of square roots, giving the values of $\sqrt{a}$ and $\sqrt{10a}$ side by side, very conveniently, for values of a from 1 to 1000.

Lehrbuch der praktischen Physik. By F. Kohlrausch. Elfte Auflage. Pp. xxxii+736. (Leipzig: G. B. Teubner, 1910). Price 11 marks.

It is not necessary in general to say anything in praise of a book which reaches its eleventh edition, but there are special circumstances accompanying the appearance of the eleventh edition of the late Prof. F. Kohlrausch's "Lehrbuch der praktischen Physik" which justify a few remarks. In the first place, the preparation of this edition was one of the latest occupations of its author, who died in January (see Nature, February 3), a few days after its appearance. Through-

out the forty years the work has been in the hands of students of physics, it has remained the pet child of its creator, and every page bears evidence of the care he bestowed on it. In the work of revision for the present edition, Kohlrausch was assisted by a number of his former pupils, now distinguished for their researches in special branches of the subject, so that it embodies the experience of the leading physicists in Germany. As an example of a section of the book only possible under a system of collaboration of this kind, that on radio-activity, by Prof. E. Dorn, may be mentioned as of special value. As a result, we have a book thoroughly up-to-date, which, as a work of reference for the physical laboratory, stands in a unique position, both on account of the large amount of valuable matter it contains, and for the completeness of its references.

In the second place, the author gives us in the preface a glimpse at the physical laboratories of Germany fifty years ago. There were then about two dozen professors of physics, a dozen assistants, and possibly about two dozen senior students engaged in research in the whole of the country. Apparatus was scanty, and had to be purchased out of a very meagre annual grant. A new professor who could bring with him his own apparatus, was regarded as a special windfall. Systematic instruction in practical physics was given at Königsberg, Berlin, and Heidelberg Universities only, but the need for better organisation of the universities in this respect soon became pressing, and was met by the appointment, in the later 'sixties, of a number of professors who had received their practical training in the above laboratories under Neumann, Magnus, and Kirchhoff. The change which has come about since then is remarkable. There are now many single laboratories in which a greater number of senior students are engaged in research than were so occupied in the whole of the laboratories of the country half a century ago.

The Schoolmaster's Year-book and Directory, 1910. A Reference Book of Secondary Education in England and Wales. Pp. lxxi+448+700. (London: The Year-book Press, c/o Swan Sonnenschein and Co., Ltd., 1910.) Price 7*s*. 6*d*. net.

This is the eighth annual issue of what has become an indispensable source of information to the educational worker. It consists of three parts, containing respectively general information, alphabetical lists of secondary schoolmasters, and a list of secondary schools. We are able to say from experience that the educational particulars provided by this work are accurate and up-to-date. Among new features of the book this year are important alterations in the section dealing with county and borough education authorities. It is interesting to note that the directory now contains more than 14,000 names, and that the list of secondary schools numbers about 1500. Altogether, the book deserves a wide circulation.

Egypt and the Egyptians. By the Rev. J. O. Bevan. Pp. xxii+224. (London: George Allen, 1909.) Price 5*s*. net.

This is a compilation of miscellaneous information about "Egypt and the Egyptians, their History, Antiquities, Language, Religion, and Influence over Palestine and Neighbouring Countries," written in old-fashioned style. It has no particular plan, and meanders about from one subject to another, but not unpleasantly. Sir G. H. Darwin, who disclaims "anything more than the superficial knowledge of Egypt which is open to any hurried tourist," has done Mr. Bevan the honour of writing a preface to his little book, which will no doubt give considerable pleasure, and convey a good deal of information and instruction to many readers.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Term "Radian" in Trigonometry.

Dr. Thomas Muir, in his letter in Nature of April 7 (p. 156), corrects the misapprehension implied in the "New English Dictionary," viz. the supposition that the word "*radian*" was first introduced in the "Treatise on Natural Philosophy" by Thomson and Tait.

Dr. Muir says he used the word in 1869 in St. Andrews, and goes on to say that it was after conversation with my father, the late Prof. James Thomson, in Glasgow, that the word was finally adopted in 1874.

I should like to point out that my father adopted the word some years before he came to Glasgow and before he met Dr. Muir. I have a memorandum in my father's writing saying that this name was proposed by him in July, 1871, and it appears in the printed examination questions set by him in the general class examination in Queen's College, Belfast, on June 5, 1873, and published, I believe, in the college calendar.

I well remember several conversations between my father and Dr. Muir with regard to the use of this and other words, but "*radian*" had already been adopted publicly by my father, and apparently had been already independently used by Dr. Muir. James Thomson.

22 Wentworth Place, Newcastle-on-Tyne, April 12.

The Yellow Colour in the Stoat's Skin.

In her letter to Nature of March 24 Miss I. Sollas remarks on the "canary-yellow" colour "in members of the stoat family when the winter whitening is incomplete," adding, "there can thus be little doubt that the yellow body produced artificially in the fur of the albino rat is a substance similar to the yellow pigment of the stoat's winter coat. . . ." I do not know whether it has been recorded, though I should have thought so, that a stoat's fur of the purest white will, after exposure to light in a museum case for a time, varying with the intensity of the light, invariably turn distinctly yellow—fainter, however, than "canary-yellow." I have made no chemical or microscopical examination of fur so yellowed, but the usual reason assigned for the change is the absorption by the hairs of a small amount of fat out of the skin, induced by the light and heat of summer. I understand, also, that ermine kept in a dark chamber or box the temperature of which is high will also turn yellow. Stoats in this part of the country often become white early in the season before any real cold weather has occurred. Henry O. Forbes.

The Museums, Liverpool, April 12.

Transit of Halley's Comet across Venus and the Earth in May.

I beg to direct attention to the following:—

It is my intention, at Kaafjord, in Finmarken (in the north of Norway), together with my assistant, Mr. O. Krogness, to take magnetic and atmospheric observations during the period May 7 to June 1 next in connection with the transit of Halley's comet across the sun's disc on May 18–19.

It is conceivable that the tail of the comet may consist chiefly of electrical corpuscular rays; and, if this be so, we should expect that these rays, owing to earth-magnetism, would be drawn in, in the Polar regions, in zones analogous with the aurora zones, assuming the tail of the comet to be of sufficient length to reach the earth.

These rays will then, in such a case, exercise, amongst other things, magnetic influences and electric inductionary effects, especially strong in the Polar regions, and it is particularly such effects we are desirous of tracing. The tail of the comet, if it should consist, as above assumed, of such radiant matter, will alter its shape at a very considerable distance from the earth, and we may expect to

see similar formations of light to those which occur during my experiments with kathode rays around a magnetic terrella.

In my work, "The Norwegian Aurora Polaris Expedition, 1902–1903," descriptions will be found in several places of these phenomena, but to elucidate the subject here I append a few new illustrations, which show very plainly the shape of these formations of light.

Figs. 1 and 2 show how the rays are drawn in in belts around the magnetic poles of the terrella, corresponding

Fig. 1.

Fig. 2.

Fig. 3.

with the polar-light zones on the earth. They are taken looking along and perpendicular to the magnetic axis. Fig. 1 shows the spiral rings of light around a magnetic north pole, corresponding to the south pole of earth magnetism. We find these belts of light sometimes, as here, with a tolerably even strength of light like a continuous band, and at other times we find the rays concentrated in three limited streaks, with well defined positions around the magnetic poles of the terrella.

Fig. 3 also shows an equatorial ring. This phenomenon of light is magnificent, but unstable; it is difficult to produce; it may suddenly appear and suddenly vanish, as the rays which run round the terrella at the equator are difficult to obtain sufficiently concentrated for the rarefied gas to illuminate them. At the lower part of Fig. 3 and on Fig. 4 a characteristic pointed tongue of light will be seen, which is drawn in, and shows the manner in which the rays here come into the terrella. The magnetic equator is indicated on the terrella by a dark line.

Fig. 4.

It may now be imagined that analogous formations of light may be observable around the earth of the rays from the comet's tail on May 18–19. The downward rays in the Polar regions will, it is true, be difficult to observe in northern parts owing to the northern declination of the sun, but in Antarctic regions there may be more hope of doing so, and the phenomenon would then probably appear somewhat similar to the aurora australis. At night, in low latitudes, one may conceive the possibility of a ring like the equatorial ring being observable.

About May 2 the comet will be in the vicinity of Venus (see *Bulletin de la Société astronomique de France*, February, p. 57), and it is not impossible that indications of an alteration in those parts of the comet's tail nearest the planet may be noticeable.

We may then possibly expect to find traces of the rays being drawn in towards the polar regions of Venus in a manner similar to that demonstrated by the experiment shown in Fig. 4, or a more or less distinct bending of the comet's tail, assuming Venus to be magnetic.

The probability of such being visible must, however, be admitted to be small, as the central line or the tail, if it is directly away from the sun, will be at a considerable height above the planet; but I desire, nevertheless, to direct the attention of astronomers to these conditions, as Venus, if as strongly magnetised as our earth, must be expected to exercise a noticeable influence on the tail of the comet at a distance of several million kilometres, especially if the rays in the tail are easily deviated by magnetic force.

This phenomenon may, in case it is present, be determined by astronomical observations of the comet's tail and Venus in the period May 1–3, and I beg, therefore, to ask astronomers, in the interests of science, to make arrangements for the necessary observations, if possible, and to favour me with a short account of the results.

Kr. Birkeland.

Universitetets Fysiske Institut, Christiania,
March.

Neutral Doublets at Atmospheric Pressure.

In his papers on magneto-kathode rays, Prof. Righi assumes the presence of neutral doublets, formed of a positive and negative ion in more or less stable combination. Sir J. J. Thomson has independently put these in evidence very clearly in his experiments on positive rays. Working independently, we have made some observations which point to the existence of such doublets at atmospheric pressure. Ionised gas is drawn through two insulated metal tubes; along the axis of each a thick insulated wire electrode is fixed. These wires can be connected in turn to a Dolezalek electrometer, and the current between tube and electrode measured. The ionised gas is produced by splashing mercury, or by heating lime or aluminium phosphate on a strip of platinum foil. With a certain blast, in one case, the current reached its saturation value on the first electrode with a voltage of 320, being then 130 in arbitrary units. Raising the voltage to 656 did not increase this by one division; the extreme readings at the intermediate voltages were 128 and 130, so that the observations were quite regular. Nevertheless, with 656 volts on the first electrode a current can be detected at the second, this in some cases amounting to as much as 10 per cent. of the original.

Lime gives a large excess of negative, mercury and aluminium phosphate of positive, ions, but in each case

tried the currents on the back electrode were practically the same, independently of the sign, while the same ionising agent was used. The saturation curves also present a peculiarity in a large number of cases. The curves become nearly horizontal at about 240 volts, after which they rise again rather rapidly, and finally become flat at about 320 volts. Each of these results is readily explained if we assume the presence of neutral doublets, which are broken up either by collisions or by the action of the field. Further experiments are being made.

A. E. Garrett.
J. J. Lonsdale.

Cass Institute, E.C., April 13.

The Etiology of Leprosy.

In Nature of April 7 I have read with interest the article on Dr. Ashburton Thompson's report on "Leprosy in New South Wales." In that report Dr. Thompson (one of our foremost authorities) has repeated a statement made in several of his former papers avowing distrust in the doctrine of contagion and in the efficacy of isolation as a preventive measure. In commenting, with surprise, on his opinion, the writer of the article says:—"One would have thought that the success which has attended the practice of isolation in Norway during the past forty years afforded sufficient evidence of its value even to the most sceptical."

Now I am quite with Dr. Thompson in his opinion, and must ask to be allowed to state in the clearest possible terms that not only is there no reason to believe that attempts at isolation have taken any share whatever in the diminution of Norwegian leprosy, but much to the contrary. That the disease has declined, and continues to decline, is happily true. The *propter hoc*, however, fails utterly when we recognise that there has been during this period of its decline no increase whatever in isolation. There has never been in Norway any isolation directed against contagion. The first large leper hospitals in Norway were built by those who did not believe the disease contagious (Dr. Danielsen and others), and who wished simply to prevent marriages and to provide comfortable homes. When the bacillus was discovered, the old theory of contagion was revived, and subsequently certain legal enactments were passed, but there was no increase in arrangements for isolation. Quite the contrary. From that day to this the number of those isolated has been progressively reduced. The lepers have been left at home with their relatives. Yet the disease has declined. It may be noted that it was declining before. It must be obvious that it has been dying out under some other influence, and that the asylums, which no one had thought it worth while to provide, could not possibly be the cause. Let me in passing just remark that during the same period a parallel effort for the extirpation of leprosy was being made in South Africa. There efficient isolation laws were passed, and plenty of accommodation provided. Without flinching, compulsory isolation was carried out. The result has shown a steady and alarming increase in the disease.

Compulsory isolation has never been attempted in Norway, and it has been rigidly enforced in South Africa. The results have been conspicuously opposite to what believers in contagion would expect. The true explanation in each case is, I believe, not difficult to give, but I must not intrude upon your space further than simply to assert that it has nothing to do with belief in contagion and attempts at isolation. Dr. Thompson is, I think, more than justified in the doubts which he has expressed, and it rests with those who in future quote the Norwegian facts to show that they really bear the interpretation which they give to them. Jonathan Hutchinson.

Sir Jonathan Hutchinson's views on the etiology of leprosy are well known to be opposed to the generally accepted view that it is an infectious disease caused by Hansen's bacillus. They were again brought before the second International Conference at Bergen, August 16–19, 1909. Nevertheless, the conclusions carried by the delegates were opposed to them. The second International Scientific Conference for the suppression of the disease reaffirmed in all aspects the conclusions adopted by the first conference in Berlin, 1897, when the attitude of Dr. Ashburton Thompson towards the accepted etiology was before the delegates. Leprosy was affirmed to be a disease communicable from one person to another. No country, no matter what its geographical situation may be, is secure against infection, and the adoption of proper measures against this possibility was recommended:—"Having regard to the favourable results which have been obtained in Germany, Iceland, Norway, and Sweden, by isolating the patients, it is desirable that infected countries should adopt the same measures."

In Norway the law, as formulated again in 1885, gave the Sanitary Commission or Board of Health in each district the right to order a leper, if he will live at home, to have his own room—at least his own bed; his clothes ought to be washed separately; to have his own eating apparatus—spoon, fork, knife, &c. If he cannot, or will not, conform to this regimen, he is obliged to enter an asylum. There are those who hold that leprosy is less easily communicated from the sick than is consumption. Dr. Thompson apparently implies that "special precautions therefore seem to be unnecessary" in leprosy because in the past they have been ignored for tuberculosis; but, in the opinion of the writer, it would be of enormous advantage to the public weal if the regulations as applying only to lepers remaining at home could be enforced in regard to tuberculosis. As a matter of fact, the success of the leprosy laws in Norway has led, on the initiative of Dr. Claus Hansen, brother of the discoverer of the *Bacillus leprae*, to the enforcement of analogous regulations as prophylactic measures against tuberculosis in that country since 1900.

It alters nothing in the efficacy of segregation that it was applied in Norway by Danielsen before Hansen—Danielsen's pupil, I believe—had discovered the lepra bacillus. Nor will any useful purpose be served by discussing the efficacy in the application of the law of segregation in Norway as impugned by Sir Jonathan Hutchinson. Dr. Ashburton Thompson's criticisms had been carefully studied by the writer of the article and passed in silence as special pleading—moderate, able, even eloquent—but as unconvincing to him as they have been to the expert delegates at two successive international conferences, the second of which was held in Norway itself.

The Writer of the Article.

Auroral Display.

There was a very fine display here of the aurora between 8 and 9 p.m. The nature of the phenomenon was sufficiently clearly marked to deserve more than a passing notice.

The curtains and shafts of light all had their origin overhead, radiating from a point a few degrees to the north of Castor and Pollux. At times as many as five curtains of light could be seen close together near the radiant centre, some of them spreading over the southern and others over the northern sky. When viewed to the north or south the thin veils showed streaks of light all radiating from the point of origin overhead. When viewed towards the east or west, *i.e.* end on, the light was most brilliant, and the wavy nature of the hanging curtains of light most marked.

For at least an hour these curtains or hanging veils of light could be seen originating above and spreading in all directions, north, south, east, and west. The radiating effect was, of course, due to perspective. There was very little wind at the time, and the curtains of light seemed to travel with it. Another effect which was most marked was that the east and west end of a curtain descending to the north of the point of view curved towards the north, whilst the ends of those curtains which descended to the south of the point of view of the observer curved to the south. This curving only showed itself when the curtains were low down and losing their brilliancy. There could be no doubt but that the whole phenomena originated in a comparatively small area to the north of Castor and Pollux.

The day had been fine and bright, and the ground was free from snow. Towards half-past nine the sky became hazy. R. M. Deeley.

North Battleford, Saskatchewan, Canada,
March 28.

THE FREE ATMOSPHERE.[1]

THE publication referred to below adds yet another to the series of memoirs issued by the Meteorological Office in the past few years. It furnishes an example, of comparatively rare occurrence in original scientific investigation, of the successful cooperation of private and official enterprise.

The introduction by Dr. Shaw contains a short historical account of the progress made in the investigation of the upper air and a summary of the more important results obtained. It includes a welcome bibliography of the chief English publications on the subject.

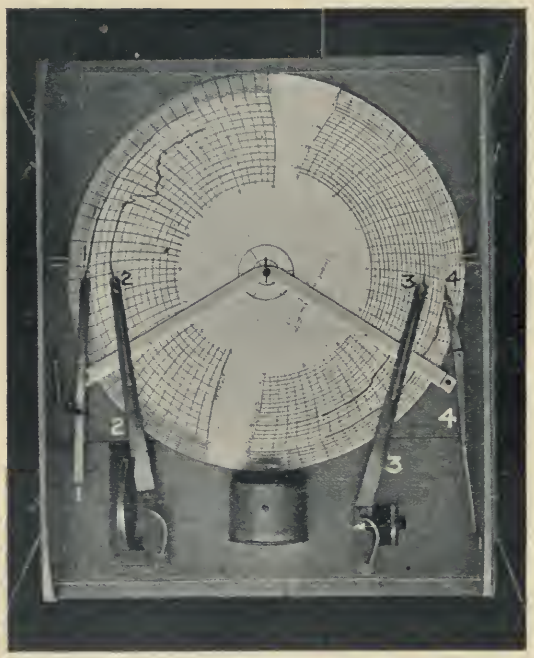
The work in this country was begun so long ago as 1749 by Wilson and Melville, of Glasgow, and the balloon ascents of Jeffries, and, later, of Welsh and Glaisher, maintained our position in the forefront of upper-air research. After a period of comparative inaction, the investigation was renewed at the instigation of Mr. Dines at the beginning of the present century. Dines began his work on the west coast of Scotland in 1902–4, and continued it, first at Oxshott, 15 miles south-west of London, and afterwards at Pyrton Hill, 40 miles west by north of London.

The report deals with kites, pilot balloons, and registering balloons, and contains a summary and brief discussion of the results obtained.

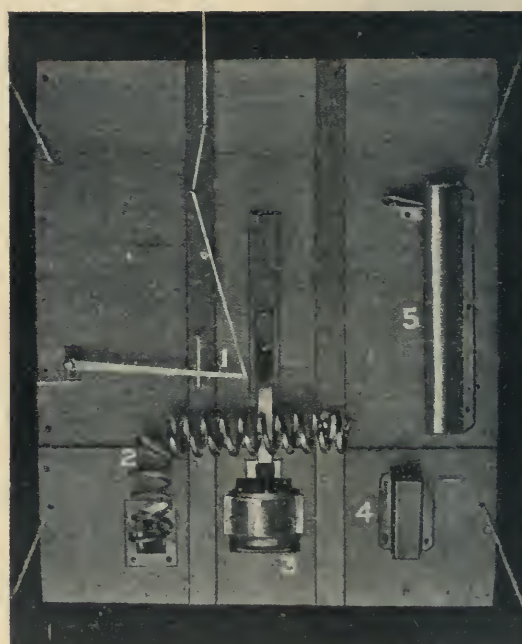
Three kinds of kites, all of the box pattern, are used at Pyrton Hill. No. 1 is 9 feet high, and has sails 3 feet wide and 18 feet long. It is used in light winds. No. 2, for standard use, is very similar, but the sails taper from 3 feet at the front and back sticks to 2 feet 4 inches at the sides. No. 3 is only 7 feet high, and the sail edges form arcs of circles, the width of the sails being 2 feet 6 inches at the sticks and 1 foot 6 inches midway between them. This kite is used if the wind aloft is likely to exceed 40 miles per hour. Steel piano wire, 1/32 inch in diameter, having a breaking strain of 250 lb., is used with all the kites.

If, when a kite is flying, it appears probable that putting on more kites, or letting out more wire, will increase the strain to more than 100 lb., the attempt is not made owing to the risk of breaking the wire, especially as records from greater heights can be obtained with registering balloons. It ought, however, to be borne in mind that the results for temperature and humidity obtained by balloons are less trustworthy than those obtained by kites, and this is of especial importance in connection with the daily variations. A kite can be kept for some time at a nearly constant level, and the kite and instruments remain exceptionally well ventilated without artificial means.

Dines's use of embroidery cambric at 9*d.* per yard, and black dress lining at 5*d.* per yard, for his sails recalls Stokes's marked preference of candles for his optical experiments. The art of using the simplest things to the best advantage runs some danger of being lost in the laboratories of ready-made apparatus and "arranged" experiments. It is refreshing to find instances of it in an official publication.



A



B

FIG. 1.

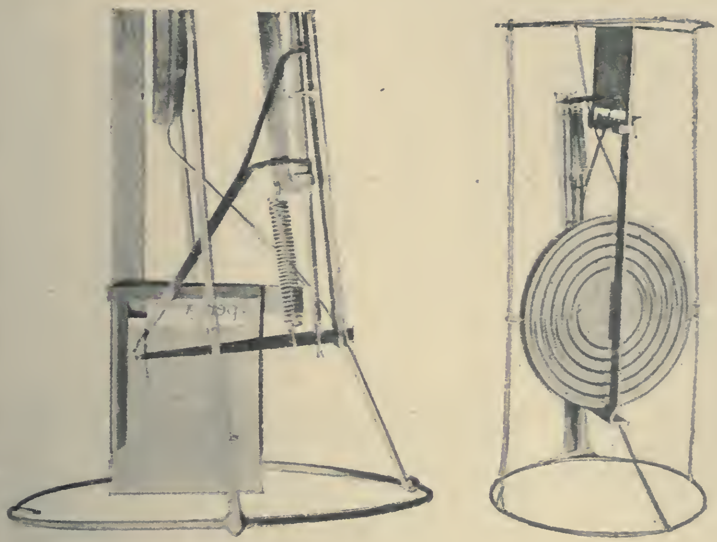
A good deal of trouble is taken to make clear, by diagrams and description, the method of letting-out and winding-in the kite wire. Mr. Dines having discovered, by long practical experience, the places where difficulties arise has taken the trouble to invent the necessary safeguards and to give to others the benefit of his labours.

The meteorograph used with kites is shown in Fig. 1, A, B.; Fig. 1, B, shows the exposed under-surface of the apparatus. The separate parts are (1) the lever and thread of the anemometer; (2) the thermometer, a spiral metal tube containing spirit; (3) the clock; (4) the cover of the aneroid barometer; (5) a metal cover protecting the hair of the hygrometer. In Fig. 1, A, the recording pens are (1) humidity, (2) atmospheric pressure, (3) temperature, (4) wind velocity. The surface shown in Fig. 1, A, is covered by waterproof cloth

[1] M.O. 202. "The Free Atmosphere in the Region of the British Isles." Contributions to the Investigation of the Upper Air, comprising a Report by W. H. Dines, F.R.S., on Apparatus and Methods in use at Pyrton Hill, with an introduction and a note on the Perturbations of the Stratophere by Dr. W. N. Shaw, F.R.S., Director of the Meteorological Office. Pp. iv+56. (London: H.M. Stationery Office, 1909.) Price 2*s.* 6*d.*

when in use. The instrument is tied in the middle of the kite, partly for convenience, partly, presumably, to shelter it from direct sunshine.

The record is made on the cardboard disc shown in



A Fig. 2. B

Fig. 1, A. The difficulty of procuring cardboard which is not warped by varying humidity, and the occasional thickening of the trace through the running of the ink, suggest that it would be an improvement to use a smoked metal sheet.

The anemometer deserves special mention because it is simple and unique. It consists of a light celluloid ball of 3 inches diameter suspended by about 40 feet of fine cotton, and the velocity of the wind is deduced from the tension in the cotton. The effect of the wind on the cotton is neglected, but it appears doubtful if this is justifiable. With cotton 0·2 mm. in diameter, the area exposed to the wind is nearly one-third that of the ball used.

Pilot balloons are usually small balloons 2–3 feet in diameter, which are sent up to determine the wind at different altitudes. Observations are made by theodolites at the end of a base line, or at times by one theodolite, the rate of ascent in that case being calculated from the free lift and diameter of the balloon.

It is assumed that the rate of ascent is given by

$$L = k\rho v^2 r^2 = \mu v^2 r^2,$$

where L is the free lift, r the radius of the balloon, v the upward velocity, ρ the density of the air, and k a constant. The values of μ, calculated from ten sets of observations given in the report, show great irregularity, varying between $5{\cdot}5 \times 10^{-4}$ and $15{\cdot}6 \times 10^{-4}$ in C.G.S. units, or between 1/480 and 1/170 in the units used in this part of the report (grains, feet, minutes). Unfortunately, no information is given, and no reasons are put forward, to account for the variations, beyond a vague suggestion of convection currents. It would be interesting to know how much of the variation could be attributed to (1) the deposition of dew on the balloons, (2) the effect of solar radiation on the balloon's temperature, (3) differences in the wind, (4) errors in the observations. As they stand, the results indicate that observations made with one theodolite may give very erroneous values for the wind.

An interesting table gives the values of μ^{-1} obtained by six different methods. From his experiments with a whirling machine, Dines found 240. Observation of a small 3-inch ball, falling through 200 feet, gave 280. Dines's theodolite observations give 290, those of C. H. Ley 330, and twelve ascents of registering balloons 322. Stanton found a still higher value, 354, from laboratory experiments on a 1½-inch ball. It is of interest to note the close approximation to the corresponding value, 380, deduced from the value of k given by Allen's experiments with steel balls in water.

Registering balloons of about 1 metre diameter, having a free lift of 200 to 300 grammes, are used to carry a meteorograph, which weighs, with its case, 60 grammes only (28 grammes without the case). About 60 per cent. of the balloons sent up are recovered, and it seems remarkable that the proportion is higher in winter, the season of high winds, than it is in summer. The explanation given is that when the meteorographs fall in standing crops they frequently come into contact with mowing machines, and as the instrument case resembles an old tin can it is not surprising that Hodge neglects to gather up and return the fragments. The difficulty might be overcome by attaching a partially filled small, cheap balloon, which would act as a signal for some time after the instrument reached the earth. An addition of 5 per cent. to the number recovered would compensate for the extra cost.

The meteorograph is shown in Fig. 2, and diagrammatically in Fig. 3. The aneroid box A expands under decreasing pressure and opens the frame in which it is fixed, so that E, L move across the plate beneath them. If the temperature is constant they make two parallel traces; if the temperature falls, the German silver strip M contracts more than the invar strip HC, and rotates DE about C. Thus, the abscissæ of the trace give the pressures, and the distance between the traces the corresponding temperatures. The instrument furnishes no information as to the rate of ascent.

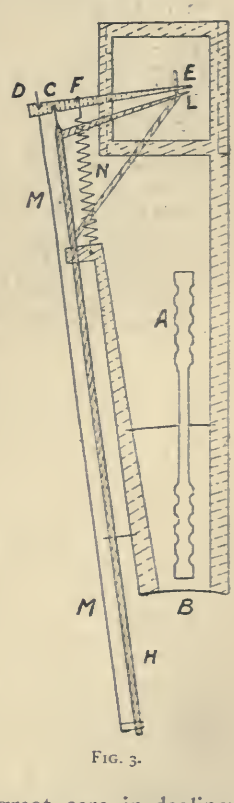


Fig. 3.

It is a great advantage that the calibration of the instrument is made on the actual plate, which is fitted ready for the ascent, and that the pressure and temperature are varied together. It ought, however, to be explained why the instrument is tested down to −40° C. and to 100 mm. only, when it is to be exposed to temperatures of −60° C. and pressures of 50 mm. or less.

The heights have been obtained from the recorded pressures by the use of diagrams, and more recently by means of semi-logarithmic squared paper. The need for great care in dealing with this problem is illustrated by the errors in the table on p. 7. On July 29 the difference of pressure

between 11 and 12 km. is 20 mm. at Manchester and 28 mm. at Pyrton Hill, which has a higher temperature at that height. Similar differences occur between 13 and 14 km., and between 5 and 6 km.

Great difficulty is experienced in reconciling the temperature observations with the observed and expected decrease in wind velocity in the advective region. The obvious errors noted above may be partly responsible for the extraordinary velocity of 150 m.p.s., found from the horizontal gradient of pressure at 16 km. But apart from errors of calculation, an error of only 1° C. in the mean temperature of the air column would produce an error of nearly 3 mm. in the pressure at 16 km. It must also be remembered that where convection is prevented the condition of steady motion may never be reached, and the differences of pressure may be equalised by translation of air across the isobars with moderate velocity.

Dr. Shaw finds that if the lower surface of the advective region is depressed owing to a disturbance in the lower atmosphere, there will be an increase of temperature of 9° C. per km. of depression. Such a depression would presumably be propagated with the same velocity as the disturbance, but the obstacles to convection in the advective region may make the upper portion of the atmosphere act as a damping agent by which the disturbance would be annulled.

The mean, maximum, and minimum values of H_c and T_c, the height and temperature at which the advective region begins, are given in the table :—

	Mean H_c	Mean T_c		H_c	T_c
Manchester	11·6 km.	219° A	Max.	15·2 km.	241° A
Pyrton Hill	12·0 ,,	217° ,,			
Dicham ...	12·2 ,,	221° ,,	Min.	7·8 ,,	204° ,,
Crinan ...	11·0 ,,	226° ,,			

The values are higher than the mean values found by the present writer and Harwood. The difference probably arises partly through the method of fixing H_c, partly owing to the exclusion of the 1909 results from the present report.

It is a pleasure to note that pressure is expressed in megadynes per cm.², and temperature in degrees C. above the absolute zero. The report is full of interest to all engaged in upper-air research, and will be especially useful to those who are contemplating the establishment of new experimental stations.

E. GOLD.

FIG. 1.—A glacier-table of unusual size met with on the lowest third of the Biafo Glacier at an altitude of about 3660 metres (12,000 feet). The rock-boulder was 5 metres (16·4 feet) long, the ice-pedestal 3·8 metres (12·46 feet) high, and the height of the whole 5·5 metres (18 feet). A table with much lower pedestal seen in distance at left. (From the *Geographical Journal*.)

THE HISPAR GLACIER.[1]

DR. AND MRS. BULLOCK WORKMAN, the well-known explorers of the higher Himalayas, have read before the Royal Geographical Society a most interesting account of the Hispar Glacier. This is one of a group of four of the world's greatest mountain-glaciers, which, together with two others of them—the Biafo and the Chogo Lungma—and some of their tributaries, have been explored from end to end by these indomitable climbers. The Hispar Glacier, one of the many feeders of the Indus, occupies a long and nearly straight valley, running roughly parallel with the crest of the Karakoram—one of the watersheds of Asia. Here that is gashed by rather short and steep transverse valleys, altogether nine in number, and attains an elevation often exceeding 20,000 feet above sea-level. On the southern side is another mountain wall, not quite so lofty, though even its lowest point is quite a thousand feet above the summit of Mont Blanc. From its western part—rather more than fifteen miles in extent—six tributary glaciers—three of them large—descend to the Hispar, but its eastern and upper portion—fully twenty-one miles in length—is practically unbroken. A rather long and flat snow saddle, 17,500 feet above sea-level, parts the Hispar from the Biafo Glacier, which descends towards the south-east, and the total length of the former, from its termination near Hispar village, at a height of about 11,000 feet above sea-level, is, according to Dr. Workman's measurement, a little less than thirty-seven miles, or a mile and a half greater than that assigned to it by Drs. Calciati and Koncza.

The pass over the Hispar and Biafo glaciers, according to Lieut.-Colonel Godwin-Austen, who, about half a century ago, explored these ice-clad fastnesses, was in former times occasionally used by natives, especially marauders, but when Sir Martin Conway traversed it in 1892[1] he found the traditions were very vague. The only serious difficulties are those due to the length of the journey at such a considerable height above sea-level. These, however, did not prevent Dr. and Mrs. Workman from spending several weeks on their way over the pass from Hispar village to Askole, and carefully studying this ice-clad region.

The Hispar Glacier has a low gradient—on the whole about one in thirty—and its average width is a little less than two miles. It receives, as has been said, six large tributaries from the northern side, and three, also large, on the lower part of its southern side. All, and especially the former, are laden with débris to an unusual extent. The effect of this is

[1] The Hispar Glacier. I. Its Tributaries and Mountains. By Fanny Bullock Workman. II. Prominent Features of its Structure. By William Hunter Workman. (*Geographical Journal*, vol. xxxv., pp. 105–131, February, 1910.)

[1] See "Climbing and Exploration in the Karakoram-Himalayas," by W. M. Conway, chapters xvi–xix. (1894.)

plainly visible on the trunk stream. Here, for a distance of nearly fifteen miles above its end, the whole surface "is broken into ice hillocks, separated by deep depressions and heavily coated with débris of every size from mud and sand to granite blocks 20 to 50 feet in diameter," such as may be seen in the gigantic glacier-table, for the picture of which (Fig. 1) we are indebted to the Royal Geographical Society. From slightly below the entrance of the Haigatum tributary a band of white ice appears among these hillocks, which broadens out as it rises until it occupies all the southern side of the glacier. On the northern side the hillocks persist for eleven and a half miles farther up. They vary in height from about 50 to 230 feet, or even more, and sometimes recall drumlins in their linear arrangement and form. Beyond these hillocks the ice, as would be expected, is fairly free from débris. In the other parts, while the lateral moraines are large, medial moraines are practically absent.

The surface exhibits some other peculiarities. Over two-thirds of its area lakelets, occupying ice-basins, are unusually common. Thus, as might be anticipated, it is but little crevassed. In fact, the only ice-fall is at the beginning of the descent from the actual pass, where the subglacial valley floor naturally steepens. In these circumstances the "hummocky" surface appears at first sight anomalous, but of this Dr. Workman offers a satisfactory explanation. The trunk stream of the Hispar receives at least a dozen tributary glaciers, most of them large. The valley, however, is a trench of only moderate breadth, bounded by steep, rocky walls. As the side streams are too strong to be ponded back by the main one, they force their way downwards side by side with it. Thus the pressure becomes greater than the resisting power of the ice, and this is squeezed upwards into ridges and protuberances. These are favourable to the formation of lakelets, which extend up to an elevation of about 16,000 feet, surface streams being correspondingly rare. Other lakelets, formed by dams of ice or moraine, occur at the side of the Hispar and its tributaries, as may be seen in Fig. 2. Intra-glacial moraines, due to the excretion of débris which has been engulfed in large crevasses, may also be observed, as well as the usual structures of *névé* and glacier-ice.

Fig. 2.—A border-lake near the junction of the Jutmaru with the Hispar Glacier. It is enclosed by a lateral moraine and the mountain-wall on the right, and the high side of the Jutmaru Glacier on the left, from which the ice-fragments floating on the water are derived. The stratification of the blackened glacial ice is well seen. Behind are the high snow-peaks walling in the Jutmaru. (From the *Geographical Journal*)

The scenery of this region of snowy peaks and giant glaciers has a general resemblance, though on a grander scale, to that of the Alps and the Caucasus, and its dominant outlines are indicative of the action of fluviatile rather than of glacial erosion. It is also worth noting that, notwithstanding the trough-like shape of the valley occupied by the Hispar ice-stream, neither the map nor the photographs suggest any marked truncation of the spurs past which it moves. Yet here, where several ice-streams are crowded into a comparatively narrow corridor, we might expect to find its rocky wall even undercut by their struggle to force a passage. The Hispar Glacier was one of several on which in 1906 the Geological Survey of India fixed marks in order to study their advance and retreat. It then appeared to be practically stationary, and had thus continued to the time of Dr. Workman's visit. So, too, had the Yengutsa Glacier, which reaches the valley-floor a little below the end of the Hispar. Yet, about five years prior to 1906, it had rapidly advanced for a distance of nearly two miles. One minor point of interest may be mentioned. Grouped spires or pyramids of snow or ice were not seldom observed, resembling the *niéves penitentes* of the Andes, to which Dr. Workman, though not without protest from Sir Martin Conway, extends the name.

T. G. Bonney.

HALLEY'S COMET.

Since its conjunction with the sun Halley's comet has been seen from several observatories, and on April 16 was seen with the naked-eye by the observers at Cape Town. Thus there is some reason for hoping that, given clear morning skies, the comet may become easily observable in England, although its low altitude at sunrise, until after it has transitted the sun on May 19, is not favourable.

The following is part of the ephemeris calculated for April and May by Dr. Smart, and communicated by Mr. Cromelin to the *Astronomische Nachrichten* (No. 4379):—

Ephemeris for Greenwich Noon.

1910	R.A. h. m.	Decl. ° ′	1910	R.A. h. m.	Decl. ° ′
April 24 ...	23 50·3 ...	+ 7 47	May 20 ...	5 3·4 ...	+19 8
28 ...	23 50·9 ...	+ 7 56	21 ...	6 9·9 ...	+17 40
May 2 ...	23 54·5 ...	+ 8 18	22 ...	7 3·1 ...	+15 14
6 ...	0 3·1 ...	+ 9 5	23 ...	7 44·8 ...	+12 40
10 ...	0 21·6 ..	+10 30	24 ...	8 18·3 ...	+10 24
12 ...	0 38·5 ...	+11 41	25 ...	8 40·1 ...	+ 8 31
14 ...	1 5·8 ...	+13 27	26 ...	8 58·9 ...	+ 6 59
16 ...	1 49·9 ..	+15 59	27 ...	9 13·1 ...	+ 5 45
17 ...	2 23·1 ...	+17 29	28 ...	9 24·6 ...	+ 4 45
18 ...	3 7·3 ...	+18 51	29 ...	9 33·8 ...	+ 3 50
19 ...	4 3·2 ...	+19 43	30 ...	9 41·4 ...	+ 3 15

As will be seen from the ephemeris, the comet, when near the sun, will travel very quickly across our line of vision, traversing Aries, Taurus, Orion, and part of Gemini between May 16 and 22.

On May 20 the distance of the comet from the earth will be about fourteen million miles, but by May 30 this distance will have increased to more than forty million miles.

The two diagrams here given show, roughly, the conditions of observation, Fig. 1 for the eastern apparition, Fig. 2 for the western. In Fig. 1 the stars are shown approximately as they appear to an observer in London looking due E. one hour before sunrise (*i.e.* 3.30 a.m.) on May 1; the dated circles represent

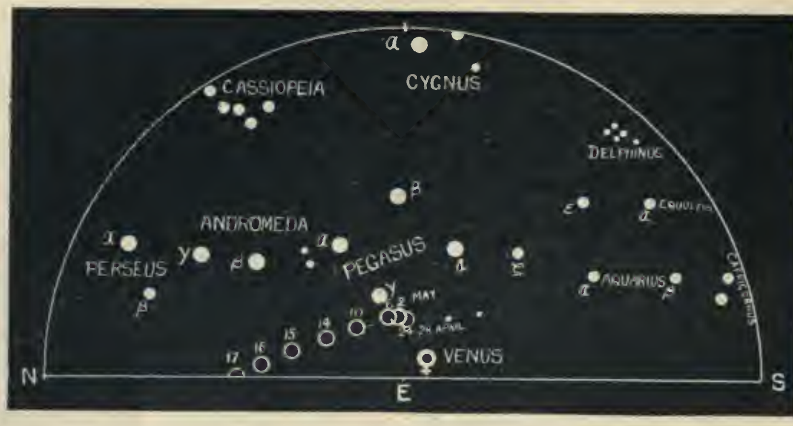


FIG. 1.

the approximate positions of the comet for the date given. Unless the eastern sky is fairly clear it is questionable whether Venus will be seen. It is obvious that to see the comet during its period as a "morning star" one must get away from the smoke-laden horizon found near large towns, and ascend to as great an altitude as possible. The observation will probably not be a simple one, for at this time of the year the sky, an hour or so before sunrise, is never dark unless cloudy; the dawn comes quite early. For this morning apparition, the Great Square of Pegasus should act as a splendid "warner" and landmark, just as it did in the evening apparition of comet 1910*a*. This mutual association of the two comets with Pegasus affords a good example of one of the chief difficulties experienced by those astronomers who have endeavoured to trace Halley's comet amid the mass of brief and very general records of comets in ancient chronicles. Fig. 2 illustrates the conditions after May 20, when the comet will be an evening star; the observer is supposed to be looking due W. at one hour after sunset on May 25 (about 9 p.m.); with a clear horizon, Procyon may serve as the indicator, but in any case Gemini and Leo will afford ready landmarks. It is now the general opinion, and hope, that no chart will be necessary during the last week or so in May, for the comet gives indications that it will probably be bright enough to be seen without difficulty. One favourable point is, of course, that during the morning apparitions the tail will rise before the comet, whilst under the conditions shown in Fig. 2 it will set later.

That the comet has developed a tail of some size is shown by photographs taken at Juvisy on February 12 and at Ottawa on February 10. The former show a thin, feeble tail 1° 30′ long, the latter, which i reproduced in Fig. 3, a tail ½° long. From M Baldet's drawing, made at the Juvisy equatorial o March 5, it would appear that the southern branc shown by him, Fig. 4, was probably too faint t impress itself on the Juvisy photograph. It is inter esting to recall, here, that in the 1835 apparition th comet, for some time after passing perihelion (Novem ber 16), showed no trace of the tail, which on Octobe 15 had extended to a distance o 20°. According to Sir Joh Herschel in his "Outlines o Astronomy," the comet was no picked up, after perihelion, unti January 24, 1836, and then pre sented a small, round, well-de fined disc, rather more than 2′ i diameter.

According to a correspondent o the *Morning Post,* the comet wa seen at Greenwich Observatory as a nebulous disc, some 30″ i diameter, in the 10-inch tele scope, on the morning of Apri 18. A nucleus, from 3″ to 5 in diameter, was recognised, bu no definite tail could be see probably on account of the ap proaching daylight; there wa however, a lack of definition, o the western side of the head probably denoting the presence of the tail. With th 13-inch telescope the comet was followed until 4.2 a.m., and was estimated to be as bright as a secon or third magnitude star.

While the chance of capturing a sample of th comet, as suggested by Dr. Allen, is perhaps ver small, it is a pity that apparently no action is bein taken. The passage of the earth through a comet' tail is so rare an occurrence that even a small oppor tunity ought not to be missed. In the April numbe

FIG. 2.

of the *Bulletin de la Société Astronomique de France,* M. C. E. Guillaume suggests the liquefaction of a large quantity of air which could afterwards be treated by fractional distillation, and possibly some cometary matter recognised. He points out that very minute quantities of the rare gases, *e.g.* krypton, are thus secured from immense volumes of air, and that it is now possible to liquefy 1000 cubic metres of air per hour; as he remarks, it is just possible that by this means the chemical study of the comet

might become a by-product of an industrial operation.

M. Flammarion suggests that if there is any palpable material at so great a distance from the head, it might be possible to measure the minute rise of temperature produced by the earth rushing through it at the rate of 77 kms. (forty-eight miles) per second.

FIG. 3.—Halley's Comet, 1910, February 10. Photographed at Ottawa.

The possibility of detecting the nucleus of the comet when it is crossing the sun's disc appears to be very remote. As pointed out by Prof. W. H. Pickering, a solid dark mass would need to have a diameter of at least seventy miles in order to be detected under these conditions, and, from the fact that Herr Archenhold saw a twelfth-magnitude star transitted by the comet, on December 5, without changing either in colour or brilliancy, it is extremely unlikely that masses of this order of size are contained in the comet's head; but the Kodaikanal spectroheliograph, in the hands of Mr. Evershed, may be able to disclose the cometary vapours during the transit.

FIG. 4.—Halley's Comet, 1910, March 5. From a drawing by M. Baldet.

There have been many surmises as to what will be the effect on the earth and atmosphere. Some of these are notable only for their extravagance, but it does seem probable that an exceptional display of aurora may be generated, and also that we may experience the mistiness of the atmosphere which was generally noted in 1861, before it was known that we had passed through the tail of the great comet of that year. It has been suggested, too, that we may see the extension of the tail as a series of diverging streamers, as was also noted in 1861.

Reports from China state that the comet is being used as an omen to inflame the rioters in the disaffected districts, and that the authorities are exhibiting pictures of the comet, with accounts of its previous apparition without ill-effects, in order to reassure the inhabitants. While there is, of course, no possible likelihood of serious misapprehension in this country, it is obvious that there yet lingers a certain amount of superstition concerning the baneful effects of comets. We would suggest to all teachers that the May apparition will afford an excellent opportunity for giving real, "live" nature-study lessons, which should effectively eradicate such superstitious fancies from the minds of the rising generation.

ROMAN BRITAIN.[1]

THE first of the two volumes referred to below contains a fully illustrated account of the excavations carried out early in 1907 by the Manchester and District Branch of the Classical Association on the site of the Roman fort at Castlefield, Manchester. The second volume is a supplementary volume by the same association, describing excavations of an earthwork at Toothill, Cheshire, and at the Roman Fort Melandra.

The first volume is something more than a mere dry-as-dust description of excavations. It contains a number of very interesting and informing essays dealing with different departments of the subject, and written by experts, so that the general reader will have no difficulty in understanding the nature and value of the work that has been so efficiently carried out. Both volumes are ably edited by Mr. F. A. Bruton, of the Manchester Grammar School.

An interesting article on the name of the fort, by Prof. James Tait, shows how difficult it is to suggest an etymology of an ancient place-name which will withstand the assault of destructive criticism. The name Mancunium, which is usually associated with the Roman fort at Manchester, has been derived by various authorities from the Welsh, *main*, "a stone"; from the Welsh *man*, "a place," and *cenion*, "skins"; from the Welsh *meini cochion*, "redstones"; and from the Old Celtic *mammion*, suggesting a derivation from *mamma*, "mother." The last derivation applies to the form *Mamcunio*, one of the half-dozen different readings found in various ancient manuscripts.

Among the inscriptions found in the course of the excavations are several on altars dedicating them to the goddess "Fortune, the Preserver." The inscriptions, however, give very little information as to the details of the Roman occupation, though one inscription appears to imply that at one time soldiers from Rætia (Tyrol) and from Noricum formed part of the Manchester garrison.

Among the objects were a considerable number of coins and articles of bronze, silver, iron, and glass.

1 "The Roman Fort at Manchester." Edited by F. A. Bruton. (Manchester: University Press; London: Sherratt and Hughes, 1909.) Price 5s. net.
"Excavations at Toothill and Melandra." Edited by F. A. Bruton. (Manchester: University Press; London: Sherratt and Hughes, 1909.)

Among the pottery are some beautiful examples of "Samian" ware, some fine drawings of typical pieces by Mr. Phelps being reproduced.

An illuminating chapter on Mithras-worship in Roman Manchester, written by the Rev. E. L. Hicks, advances the theory that Mithras-worship was encouraged by the Emperors among the Roman soldiers, as an antidote to Christianity.

At the end of the volume is an elaborate catalogue of the coins of Roman Manchester, prepared by Dr. R. S. Conway, assisted by Mr. McInnes and Mr. Brooke.

The supplemental volume describes some excavations made by the association on an earthwork at Toothill, in Macclesfield Forest. This earthwork has long puzzled antiquaries, and was generally believed before these excavations were made to be a Roman camp or fort. But not a single trace of Roman occupation was found, nor of pre-Roman; the work may have been mediæval, but no positive evidence of its age has yet been found. The rest of the volume describes the continuation of the work at the Roman Fort Melandra.

Photo. by J. J. Phelps.
Samian Bowl found in Manchester in 1907. From "The Roman Fort at Manchester."

These volumes are well and clearly written, and very fully illustrated, and will be of the greatest value to students of Roman Britain.

ADMINISTRATION AND DISEASE.

THE report of the advisory committee for the Tropical Diseases Research Fund for 1909[1] contains so much original work that it should rank as a scientific publication. In it are to be found reports from all parts of the world in which the results of scientific investigations are communicated by those engaged in studies bearing directly or indirectly upon tropical diseases of all kinds. Some of these reports are even illustrated by figures, plain or coloured, which, however, for the most part, give the impression of either having been very badly drawn in the first place or very inadequately reproduced in this report. It is to be hoped that many of the important and interesting researches described here will find their way ultimately into recognised scientific or medical journals with fuller exposition and better illustrations.

The actual report of the committee occupies three pages out of a total of 134, the remainder being taken up by appendices. In the report the committee gives an account of its revenue, amounting to 3470*l.*, and the expenditure, totalling 3333*l.* 6*s.* 8*d.* The revenue is made up of contributions from the Imperial Government (1000*l.*), the Government of India (500*l.*), the Rhodes' Trustees (200*l.*), and Colonial Governments (1770*l.*); and, with regard to the last item, it is very satisfactory to learn that the Colonial Governments have one and all agreed to renew their grants for a further period of five years from 1909. The expenditure consisted of grants to the London School of Tropical Medicine (1383*l.* 6*s.* 8*d.*), the Liverpool School of Tropical Medicine (1000*l.*), the University of London (750*l.*), and the University of Cambridge (200*l.*). No grant was made to the Royal Society during the year, because the funds required for the continuation of the researches into sleeping sickness, carried on under the supervision of the society, were provided by the Uganda Protectorate.

The first appendix contains reports on measures taken for the prevention of malarial fever. A circular letter was dispatched by the Colonial Secretary to the Colonial Governors, enclosing (1) a letter from Sir William Osler, published in the *Times* of March 15, 1909, entitled "Malaria in Italy; a Lesson in Practical Hygiene," and (2) a report of the Bombay Medical Congress, published on March 16, 1909; and inquiring "to what extent the policy which Dr. Osler represents as having been so successful in Italy could be adopted in the territory under your administration." Replies are printed from Ceylon, Mauritius, East Africa, Nyasaland, Somaliland, Uganda, Gambia, Gold Coast, Sierra Leone, Northern and Southern Nigeria, South Africa, Bahamas, British Guiana, British Honduras, Jamaica, Leeward Islands, Trinidad, Windward Islands, Australia, and Cyprus. These various replies furnish much interesting reading. In general the defence of dwellings and individuals against mosquitoes, the destruction, so far as possible, of the breeding-grounds of the mosquitoes, and the free distribution of quinine, are the measures most commonly adopted. The Acting Governor of the Leeward Islands reports favourably on the efficacy of the small fish known as "millions" (*Girardinus poeciloides*) in keeping down mosquitoes. The Governor of Nyasaland reports favourably on the success of anti-malarial measures in the townships and other European settlements, but is less hopeful with regard to the scattered native villages.

The remaining appendices consist of a report from Dr. H. G. Plimmer on his work on the experimental treatment of trypanosomiasis; reports from the professor of protozoology in the University of London, the Quick Laboratory, Cambridge, the London School of

[1] Printed for His Majesty's Stationery Office, 1910. Cd. 4999 Price 2*s.* 8*d.*

Tropical Medicine, the Liverpool School of Tropical Medicine, and the various colonial laboratories; and, lastly, the circular letter sent by the Colonial Secretary to the Colonial Governors with regard to the renewal of contributions to the Tropical Diseases Research Fund. Many of these reports contain matter of much interest. From British Guiana come reports by the Government bacteriologist, Dr. K. S. Wise, and Prof. Deycke on the results of Prof. Deycke's treatment of leprosy during the first six months' trial. In the report of Dr. Castellani from Ceylon, peculiar parasites are described from the blood of man and other vertebrates in Ceylon, with illustrations of a relatively high standard. These parasites are found free in the blood-plasma and resemble the free "vermicules" of hæmogregarines, but do not appear to have any intracorpuscular stage. Dr. Castellani considers them to be Protozoa of a genus distinct from hæmogregarines, and compares them with bodies found in human blood in Algeria by the brothers Sergent, whose name is translated into Sergeant, in our opinion somewhat unnecessarily.

From East Africa the Government bacteriologist, Dr. P. H. Ross, gives an account of a number of experiments on the transmission of trypanosomes by *Glossina fusca* and *G. longipennis*. Amongst these special interest attaches to one in which a monkey was successfully infected with *Trypanosoma gambiense* by means of *Glossina fusca*, by the method of interrupted feeding. Two flies were used in this way on October 5, being first fed on an infected monkey and then transferred immediately to a healthy monkey; the experiment was repeated with three more flies on October 8; trypanosomes were first found in the blood of the second monkey on October 31. These experiments tend to show that tsetse-flies of species other than *G. palpalis* can transmit sleeping sickness by the direct or purely mechanical method.

The report shows the value and importance of the researches on tropical diseases that are being carried on in all parts of the world under the auspices of the Colonial Office and the Colonial Governments. Not only is the report encouraging for the future, but it is most interesting and instructive reading, and well worth the modest sum for which it is sold.

NOTES.

SIR ARCHIBALD GEIKIE, K.C.B., P.R.S., has been elected a foreign member of the Royal Danish Society of Sciences, Copenhagen.

THE death is announced, at eighty-four years of age, of Prof. Julius Kuehn, for many years professor of agriculture in Halle University.

THE annual meeting of the Iron and Steel Institute will be held on Wednesday and Thursday, May 4 and 5. On May 4 the retiring president (Sir Hugh Bell, Bart.) will induct into the chair the president-elect (the Duke of Devonshire). The Bessemer gold medal for 1910 will be presented to Mr. E. H. Saniter, and the president will deliver his inaugural address. A number of important papers will be read and discussed during both days of the meeting.

THE Geneva correspondent of the *Daily Chronicle* states that a monument in memory of Prof. Tyndall will be erected on the summit of the Bel Alp, 6735 feet high, a little above the place where for many years Tyndall resided during the summer months. Mrs. Tyndall has engaged M. F. Correvon, of Geneva, to design the monument, which is a large conical block of granite. It will be erected by the Swiss Alpine Club in July on Bel Alp, overlooking the Aletsch Glacier.

THE executive committee of the National Physical Laboratory has appointed Mr. J. E. Sears to take charge of the work of the metrology division of the laboratory in the place of Mr. H. Homan Jeffcott, who has been nominated recently to the professorship of engineering in the Royal College of Science, Dublin. Mr. Sears, who was formerly at St. John's College, Cambridge, graduated with first-class honours in mathematics and engineering, and is an associate member of the Institution of Civil Engineers.

UNDER the title of the *Journal of Genetics*, it is proposed to publish a periodical for original research in heredity, variation, and allied subjects. The journal will also, from time to time, contain articles summarising the existing state of knowledge in the various branches of genetics, but reviews and abstracts of work published elsewhere will, as a rule, not be included. Adequate illustrations will be provided, and, where the subject-matter demands it, free use will be made of coloured plates. The journal will be edited by Prof. W. Bateson, F.R.S., director of the John Innes Agricultural Institution, and Prof. R. C. Punnett, professor of biology in the University of Cambridge, and it will be published by the Cambridge University Press. It is hoped that the first number will be ready in August.

ON Tuesday next, April 26, Prof. F. W. Mott will begin a course of three lectures at the Royal Institution on "The Mechanism of the Human Voice"; on Thursday, April 28, Mr. W. McClintock will deliver the first of three lectures on "Blackfeet Indians in North America"; and on Saturday, April 30, Dr. D. H. Scott will commence a course of three lectures on "The World of Plants before the Appearance of Flowers." The Friday evening discourse on April 29 will be delivered by Dr. Tempest Anderson on "Matavanu: a New Volcano in Savaii (German Samoa)"; on May 6 by Sir Almroth Wright, on "Autoinoculation"; and on May 13 by Prof. W. H. Bragg, on "Radio-activity as a Kinetic Theory of a Fourth State of Matter."

AN interesting light has just been shed upon a controversy which excited some attention in 1907 (see NATURE of that year, September 26, p. 545, and October 17, p. 615) by the publication of the official report on "The Tomb of Queen Tiyi" (Constable and Co., Ltd., 1910). Two years ago archæologists maintained that the bones found in the tomb were the remains of the mummy of the queen herself, and seemed to regard as a matter of little importance the anatomical fact that the skeleton was that of a young man. Sir Gaston Maspero now states (*op. cit.*, p. i) that "when we came to examine the mosaic coffin and the sheets of gold in which the mummy was wrapped, we found that their legends asserted the mummy to be no other than Khuniatonu himself" (Queen Tiyi's son).

THE Seismological Society of America at a recent meeting passed a series of resolutions expressing its views on the establishment of a National Bureau of Seismology, and decided that copies of the resolutions should be transmitted to the President, President of the Senate, the Speaker of the House of Representatives, and the secretary of the Smithsonian Institution. After enumerating the chief earthquake disasters in the United States, and summarising what has been done in other countries for the encouragement of the study of seismology, the resolutions state that the Seismological Society of America strongly favours the establishment of a National Bureau of Seismology with power (*a*) to collect seismological data; (*b*) to establish observing stations; (*c*) to study and

investigate special earthquake regions within the national domain; (*d*) to cooperate with other scientific bodies and organisations and individual men of science in forwarding the development and dissemination of seismological knowledge. The society also favours the organisation of this bureau under the Smithsonian Institution, with the active cooperation of other scientific departments of the Government.

In the death of Sir Walter Palmer, Bart., on April 16, at fifty-two years of age, the cause of higher education has suffered a heavy loss. Nowhere will that loss be felt more grievously than at Reading, for to Sir Walter Palmer more than perhaps to any other individual the University College of that town owes its origin and rapid development. Largely to his initiative was due the merging, some twenty years ago, of the University Extension Centre and the School of Science and Art into one institution, which has become the flourishing University College of to-day. The number of the benefactors of higher education in this country is not large. The institutions which they aid make heavy claims upon them, claims, not only on their wealth, but also on their time. That these claims are met unfailingly by men like Sir Walter must rejoice the hearts of those who believe that, "after bread, education is the first need of a people." From 1897 to 1903 Sir Walter was chairman of council, and in that capacity received the Prince of Wales on the occasion of the opening of the new college buildings in 1898. After his resignation of the chairmanship he remained a member of council and of the academic board. His deep and abiding interest in education was not confined to Reading; and the work done by him in London—he was a member of the Senate of the University of London—is widely known and appreciated.

The Liverpool Marine Biological Station at Port Erin has been very fully occupied with workers during the present spring vacation. In the month from the middle of March more than forty senior students and professional biologists, representing six or seven universities, have occupied work-places. Amongst these may be mentioned Mr. Walter Tattersall (development of Littorina), Dr. Henderson (development of plaice), and two senior students, all from the University of Manchester; Dr. Stuart Thomson (Alcyonaria), from Bristol University; Mr. W. J. Dakin (memoir on Buccinum), from Belfast University; Mr. W. Riddell (plankton), Dr. J. Pearson (memoir on skate), Mr. Douglas Laurie, Prof. Herdman (plankton), and about twenty-five senior students from the biological departments of Liverpool University; Prof. Cole and three senior students from Reading; two from Cambridge, one from Birmingham, and a few others. Every work-place is now occupied, and an extension of the laboratory accommodation is urgently required. Work at sea, from the S.Y. *Ladybird*, is being carried on actively. The plankton on the surface of the Irish Sea is at present very abundant, and all the nets are giving large hauls. The vernal increase in phyto-plankton (such as diatoms) made its appearance this year between March 22 and 26, an unusually early date. Last year the phyto-plankton was not present in quantity (more than a million per fifteen minutes' haul of standard net) until April 19; in 1908 it began about the middle of April (from April 13 onwards), and in 1907 the maximum covered the last week of March and first fortnight of April—apparently the present season is more like 1907 in this respect than the two intermediate years. In the fish-hatchery the present season has been a late one, but in other respects is satisfactory. The spawning of the parent plaice (about 400 adult fish) in the pond began on February 14, but the numbers of fertilised eggs produced remained low until March 7, since when they have been spawned in abundance, the maximum on one day being 634,000, on April 12. The total number of eggs skimmed from the pond, to April 16 inclusive, is above 8½ millions, and the number of larval plaice set free in the open sea, to April 15, is 3,365,000. The spawning is still in progress, and will probably continue for several weeks.

Dr. Knut Stjerna, a promising anthropologist of Upsala, whose death, we regret to learn, occurred at an early age in November last, contributed to the January-February number of *L'Anthropologie* an elaborate paper entitled "Les Groups de Civilisation en Scandinavie a l'Epoque des Sépultures à Galerie." He recognises the remains of three races in this region:—first, the east and north were occupied by a race of fishermen and hunters, who retained much of the Palæolithic culture, and were connected across the Aland Archipelago with the people of east and south-east Europe; secondly, the Danish islands and the adjoining mainland were colonised by a people skilled in bee-culture, who possessed a regular type of weapons, and traded in the North Sea; lastly, there was on the west a foreign race, emigrants from Central Europe, possessing a civilisation which at the close of the period of the gallery tombs had begun to assert its influence on the adjoining Scandinavian races.

The question of the origin and distribution of the cross-bow in India presents an interesting problem. Mr. G. Forrest, in the *National Geographic Magazine* for February, under the title of "The Land of the Cross-bow," describes its use by a people whom he calls the "Lissoos" in the Upper Salwin valley in Burma. The bow is made of wild mulberry, with a span of 5 feet and a pull of 35 lb.; the stock is of wild plum wood, the string of plaited hemp, and the trigger of bone; the arrows are made of split bamboo, 16 or 18 inches long, and poisoned with aconite. Sir J. G. Scott describes a similar weapon in use among the Lashis or Yawyins and the Kachins. It is not mentioned by Messrs. Skeat and Blagden as in use among the Pagan races of the Malay Peninsula. Mr. Thurston, in his recent work on the "Castes and Tribes of South India," says that he found a weapon of this type in use among the Ulládans, a wild tribe of Travancore, for shooting fish, and a specimen of the weapon, now in the Pitt Rivers Museum, Oxford, was picked up among the Korwas, a wild tribe in Central India, south of the river Son. The Ulládans seem to speak of it as the Firingi (Frank or European) weapon, but it is difficult to suggest any route by which it could have reached the Burmese tribes. Being an obvious development of the common bow, it may have been independently invented by them.

At the end of an account of the birds obtained during the Alexander expedition to Alaska in 1908, Dr. J. Grinnell, in vol. v., No. 12, of the University of California Zoological Publications, directs attention to the tendency to melanism among the avifauna of the district. In this respect Alaskan birds resemble those from other regions with a heavy rainfall and damp climate. The melanism, there and elsewhere, cannot be directly attributed to the heavy precipitation, nor, in the author's opinion, to the humidity and paucity of light, but the true cause of the phenomenon is not at present apparent.

We have to acknowledge the receipt of the volume of the *Sitzungsberichte der k. Bohm. Ges. der Wissenschaften* for 1909, and among the contents we may refer

to an account by Dr. Anton Fritsch of the discovery in the granitic area of Skuč of a superjacent deposit of altered sandstone containing Rudistæ and a number of other Upper Cretaceous molluscs. Another remarkable geological discovery recorded, by Mr. A. Hofmann, in the same volume relates to the occurrence of rounded pebbles of quartzite and other rocks in the brown coal formation. The author figures specimens of these pebbles *in situ*, but reserves an explanation of their mode of occurrence.

ZOOLOGICAL serials, both English and American, are flooded with descriptions of new forms of mammals from British East Africa, the American descriptions being based on specimens obtained during the Roosevelt expedition, which appears to have induced English naturalists to overhaul the collections in this country. The chief American contributors are Messrs. Heller, Miller, and Osgood; and among a batch of papers recently received we may refer to one by Mr. Heller on a sable antelope from the Shimba Hills, which is described as a new species, although, as it differs from the typical *Hippotragus niger* mainly by the non-assumption of the full sable livery, it is better regarded as a race of that species. A similar remark is applicable in the case of several of the other new forms, which are mostly rodents, and to the Angolan hippopotamus described by Mr. Miller as *Hippopotamus constrictus*.

IN the *Zoologischer Anzeiger* of March 1 (vol. xxxv., pp. 500–8) Dr. Max Schlosser announces the discovery in the Fayum Oligocene of remains of Primates which are referred to three new genera, viz. Mœripithecus, Parapithecus, and Propliopithecus. The last, as represented by *P. haeckeli*, is a small ape intermediate in size between Chrysothrix and Cebus, with the normal simian lower dental formula, the canine and premolars being vertical, and the two branches of the lower jaw running nearly parallel and forming a firm symphysis. Phylogenetically, this genus is regarded by its describer as of high importance, since, in his opinion, it is the ancestor, not only of the Simiidæ, but also of the Hominidæ. *Parapithecus fraasi* is a small species of the size of a squirrel-monkey, with the lower dental formula *i*.1, *c*.1, *p*.3, *m*.3. It is regarded as connecting the Eocene Anaptomorphidæ with the Simiidæ, and perhaps also with the Cercopithecidæ. *Moeripithecus markgrafi* is too imperfectly known to admit of its systematic position being determined; it was about the size of a spider-monkey. Dr. Schlosser also describes a number of new types of hyracoids from the Fayum, among which Bunohyrax is based on some of the species included by Dr. Andrews in Geniohyus, both genera being regarded as bunodont hyracoids. In this connection it may be mentioned that Dr. Marcellin Boule (*Comptes rendus*, vol. cl., p. 812) has just described remains of a species of the Siwalik genus Merycopotamus from Upper Tertiary strata in southern Tunisia. This *M. africanus*, as it is named, affords further evidence in favour of Dr. Arldt's theory as to the migration of the Siwalik fauna through a forest-tract to Africa.

THE association of particular species of insects with particular flowers has always been a matter of interest to those who concern themselves with the question of the natural means of cross-fertilisation by insect agency. With respect to our native orchid, *O. maculata*, previous records have generally credited insects other than Lepidoptera as being the fertilising agents. In the *Entomologist* for November, 1909 (vol. xlii., p. 281), Prof. Meldola recorded the capture in August at Onich, Inverness-shire, of a specimen of the common "shark," *Cucullia umbratica*, with one of the pollinia of *O. maculata* attached to its head, thus proving that this moth visits the flower in question. Prof. Meldola's observation has been followed up by Mr. A. M. Stewart, of Paisley, who in the current number of the *Entomologist* (April, vol. xliii., p. 106) records *Plusia festucae* as a fertiliser of the same orchid. In view of the large numbers of moth collectors now at work in this country, it is remarkable that such few observations of this kind have been placed upon record. Photographic reproductions of the heads of both species showing the pollinium *in situ* are given in the *Entomologist* for this month.

WE have received the Year-book for 1909 of the Dairy Students' Union, a body founded four years ago to assist its members with advice on various difficulties that arise and information of vacancies occurring in different branches of dairying, and "to create and stimulate interest in scientific research and new inventions in the dairy world." The book contains several short articles by Messrs. Blackshaw, D. A. Gilchrist, T. R. Robinson, C. W. Walker-Tisdale, and other dairy writers, and there is an interesting set of replies to queries that have been sent in by members during the year and dealt with by the advisory board.

THE direct determination of the total solids in milk presents certain practical difficulties which would be of serious disadvantage to the ordinary analyst who has to make a large number of determinations. It is found, however, that a simple formula expresses with sufficient accuracy the relation between the total solids, the fat (as determined by Gerber's or similar methods), and the specific gravity determined by the lactometer. Mr. Collins has recently issued an account of a slide rule that he has invented, and is now on the market, by which the necessary calculation, including the temperature correction, may be made at one setting. Such a rule will be of great benefit to the busy milk analyst, who has hitherto had to work out the calculation in the ordinary way. The paper is published in the University of Durham Philosophical Society's Proceedings.

PRINCE GALITZIN has recently published an interesting study of the records of the great earthquake of January 22 (*Bull. de l'Acad. Imp. des Sci. de St. Pétersbourg*, 1910, pp. 211–6). He estimates the distance of the epicentre from Pulkowa at 2400 km., and its azimuth N.W. $-49 \cdot 4°$. From these data he assigns the following position for the epicentre, lat. 68° N., long. 17° W., that is, a little to the north of Iceland. This agrees somewhat closely with the position calculated by Dr. Tams from the epicentral distances from Jugenheim, Strassburg, Vienna, and Hamburg, namely, lat. $70 \cdot 3° \pm 1 \cdot 7°$ N., long. $14 \cdot 3° \pm 2 \cdot 2°$ W. According to intelligence received from Iceland, a violent earthquake took place in the neighbourhood of that island about the time mentioned.

THROUGH the courtesy of Dr. Reusch, director of the Geological Survey of Norway, we have received an abstract of the history and proceedings of the Norsk Geologisk Forening, founded in 1905, and of its predecessor, the Geologisk Klub of Christiania. This history is reprinted from the journal of the society, the *Norsk Geologisk Tidsskrift* (Bind i., 1909), and forms a complete record of investigations and discussions since 1893. Like the old Geological Club in London, the Norwegian club consisted mainly of men engaged in active geological research, and this character is maintained by its successor, the forty members of which resemble an academy rather than a general geological society. In the first volume of the *Tidsskrift* some of the papers are in German, while

others have summaries in English. Scandinavian geology, as is well recognised, has a special interest for workers on our pre-Devonian rocks and for all interested in recent modifications of our shore-lines.

The first part has appeared of the comprehensive work entitled "Handbuch der Regionalen Geologie," edited by Profs. Steinmann and Wilckens, of Bonn (Heidelberg: Carl Winter, 1910). This includes the whole of Denmark, by Dr. N. V. Ussing, of Copenhagen, and is published at the moderate price of 1.60 marks, or 1.20 marks to subscribers. The scheme of the editors is already in full operation, and some sixty contributors of various nationalities are at work on the subdivisions of the eight royal octavo volumes. Landscape illustrations are excluded, but sketch-maps and sections are given in the text. The references to original memoirs are likely to be especially useful. The present part of 38 pages, so convenient to carry in the hand-bag, will form a companion for all scientific visitors to Denmark. One of the maps shows how the post-Glacial uplift of Scandinavia has affected a large part of the Danish peninsula and the islands. Bornholm falls into the Scandinavian region, and contains rocks from the pre-Cambrian up to the Liassic systems, unknown otherwise in Denmark. Attention is directed to the Middle and Upper Jurassic and Lower Cretaceous strata of Jutland, represented only by boulders in the drift. The various oscillatory movements that have given the kingdom its present outlines are well stated on p. 26.

A preliminary report on the mineral production of Canada during the year 1909 has been prepared by Mr. John McLeish, chief of the Division of Mineral Resources and Statistics, and published by the Mines branch of the Canada Department of Mines. The total value of the mineral production during the year was upwards of 18,000,000*l.*, an increase of 5 per cent. over 1908. Of this total, 49·9 per cent. represents metals, 49·7 per cent. non-metallic products, the remaining 0·4 per cent. being mineral products not reported. Coal is still the most important Canadian mineral, and constitutes 27 per cent. of the total. Silver occupies second place with 15·9 per cent., gold and nickel come next with 10·8 and 10·5 per cent. respectively, and copper contributes 7·8 per cent. The metals nearly all showed an increased output compared with 1908, while in the non-metallic class there is a larger number of products showing increases than those showing decreases. The increases were very noticeable in the cases of corundum, gypsum, natural gas, salt, and in the structural materials, cement, clay products, lime, and stone.

In a paper published in Petermann's *Mitteilungen* Dr. Marquardsen, of Göttingen, reviews the present state of our knowledge of the topography and hydrography of the inland drainage area of the Sudan and Sahara. The total area of this region is estimated at 2,139,000 square kilometres. Dr. Marquardsen states some interesting results with regard to Lake Chad; the variations in size and level do not, in his opinion, indicate a progressive change in climate since its discovery by Denham in 1823; the lake appears to be shifting northward and gradually filling up. The question of the ultimate filling up of the whole basin, and breaking through of the streams which now supply Lake Chad, is discussed; and in this connection special significance is attached to the Logone-Tuburi bifurcation and the activity of the source streams of the Benue.

The climatology of 1909, as recorded at the Juvisy Observatory, is reviewed by MM. Flammarion and J. Loisel in No. 2 (1910) of the *Bulletin de la Société astronomique de France*. The form of the discussion and of the comprehensive set of curves follows that of previous years, each element in the climatological record being discussed separately and compared with the same element in former seasons and years. Thus we see that 1909 was one of the coldest years since 1885, the mean temperature for the year (9·5° C.) being the lowest since 1891; in the matter of mean summer (June, July, August) temperature the value (16° C.) was the lowest since 1886, when the records were commenced. Similarly interesting comparisons are made for the other elements.

Messrs. Geo. Philip and Son have sent us a cardboard model, designed by Mr. Rupert Hicks, to show the relative positions of Halley's comet, the sun, and the earth during the present apparition. The model consists of a piece of stout cardboard 12 inches by 10 inches, near the centre of which is fixed a gilded disc representing the sun. Attached by an arm to the latter is a circle representing the earth, the revolution being provided for by the sun being pivoted at the centre. Then on a longer arm is affixed a model comet, which may describe an arc representing that part of the comet's path lying within the orbit of the earth. Thus one gets the comet's path, relative to earth and sun, from March 10 to May 30, and, by swinging the discs into their appropriate positions on the dated arcs, it is possible to see at a glance the conditions governing the visibility of the comet and its tail on any specified date; the tail is made long enough to illustrate the probable passage of the earth through it on May 19. The price of the model is 1*s.* net, post free 1*s.* 1*d.*, and as a method of illustrating to non-astronomical people the various conditions under which the comet appears and disappears the model should prove instructive and interesting.

The February number of the Journal of the Institution of Electrical Engineers contains a communication made to the Manchester section of the institution by Mr. J. W. Warr on the electric ignition of internal-combustion engines. Descriptions of the principal methods of electric ignition at present in use are given, but the author expresses a decided preference for the high-tension method both for stationary engines and for motor-cars. The simplicity of the means of production of the current for low-tension methods is more than compensated by the trouble introduced by the mechanical contact breakers which are then necessary to produce the spark. Of the various high-tension methods, Mr. Warr considers that depending directly on a magneto machine to be the most trustworthy.

According to an article in the February number of *Le Radium*, M. T. Bialobjeski has commenced at the Collège de France an examination of the effects of the β and γ rays of radium on the conductivity of solid dielectrics. His method is to use the dielectric in a condenser the plates of which are horizontal, the lower one being connected through an electrometer to earth, while the upper one consists of a thin sheet of aluminium foil kept in contact with the dielectric by means of a ring of lead. The rays from 1 milligram of radium bromide contained in a platinum capsule closed by a mica window fall on the upper plate of the condenser and pass through it to the dielectric beneath. The potential difference between the plates is maintained by storage cells, and can be increased to 1800 volts. The current produced is measured by the rate of motion of the electrometer needle. Sulphur, paraffin, wax, and amber have up to the present been examined. For discs more than 1 millimetre thick the current was proportional to the electromotive force used.

For smaller thicknesses the behaviour varied greatly with the material, but the author hopes to explain the whole of the phenomena observed by means of the ionisation theory.

THE launch of H.M.S. *Colossus* was carried out successfully on Saturday, April 9. This vessel has been constructed by Scott's Shipbuilding and Engineering Company, of Greenock. That the work has been carried out expeditiously will be evident from the fact that the keel was laid less than nine months ago. The ship will have a displacement of 20,250 tons, and has a length of 510 feet, beam 86 feet, and a designed speed of 21 knots. Parsons turbines and Babcock boilers of 25,000 horsepower will be fitted, and good progress has been made with these also. The launching weight was 7500 tons, and the vessel was completely afloat 58½ seconds after the first movement, which occurred without the vessel hanging on the ways for any appreciable time.

AN interesting article on the development of the hydraulic reaction turbine in America, by H. Birchard Taylor, appears in the *Engineering Magazine* for March. American makers have advanced greatly since 1890, and have abandoned the methods of "trial and error" in vogue prior to that date, methods which caused the Niagara Falls Power Company to go abroad for the designs of their first machines. To-day, American designers are in a position to design and construct machinery to meet the most severe requirements, and have to their credit the largest turbines in the world, among which may be mentioned the four 13,000-horse-power Francis turbines, now operating in the plant of the Toronto Power Company at Niagara Falls. The author of the article has given special attention to erosion, and brings forward evidence which indicates that trouble owing to this cause may be eliminated by correct design. Thus a bronze wheel under a head of 266 feet was so eroded at the end of a few months that it was necessary to replace it. A new wheel, of slightly different design, but of precisely the same material, ran five years without showing any signs of wear. Electrolysis and chemical action are considered by Mr. Taylor, who believes that both can be eliminated by properly designing the wheel blades.

THE issues of *Engineering* for April 8 and 15 contain a detailed account of some experiments upon the flow of water over triangular notches, carried out by Mr. James Barr at the James Watt Engineering Laboratories at Glasgow University, under the supervision of Prof. Archibald Barr. The late Prof. James Thomson first investigated this form of notch in 1860 and 1861 with rather crude apparatus. It speaks well for his skill as an experimenter that the present series, with elaborate and finely constructed apparatus, show no divergence from Thomson's conclusions. Thomson's law, that the quantity flowing is, in almost all cases, proportional to the 5/2 power of the head, has been verified. Further investigation shows that the prevention of the inward flow of the water at the sides of the notch, whether caused by the narrowness of the channel of approach or by the roughness of the upstream surface of the notch, produces an increase in the quantity flowing over the notch. Various notches were experimented upon, the value of the coefficient in Thomson's formula for a narrow surface, right-angled notch being found to vary from 0·3104 at a head of 2 inches to 0·2995 at a head of 10 inches. Thomson's average value of 0·305 for heads from 2 to 7 inches must have been very near the truth. The articles are well illustrated, and give full tables and curves of results.

MESSRS. CONSTABLE AND CO. are publishing immediately a little book of pocket size, being a "Guide to the Preservation of Health in West Africa," by Mr. Henry Strachan, principal medical officer in southern Nigeria. They announce also the forthcoming publication of a series of essays dealing with the consideration of the introduction of an international language into science. Such a language has been constructed by an international commission, and the English edition of the essays in which it is presented is by Prof. F. G. Donnan.

MESSRS. W. WESLEY AND SON, Essex Street, Strand, London, W.C., have just issued a classified catalogue of manuscripts, books, and pamphlets on astronomy, including the libraries of the late Miss A. M. Clerke, Dr. A. A. Common, Mr. E. Crossley, and Captain W. Noble. The catalogue includes the titles of about 3700 works, arranged in alphabetical order, according to authors' names, in groups relating to the various branches of theoretical and practical astronomy and astronomical physics. The classification renders it easy to find the works which Messrs. Wesley have available upon any particular subject of astronomical study or research, and all who are desirous of filling up gaps in their libraries should see this catalogue.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF COMETS.—In No. 4402 of the *Astronomische Nachrichten* Dr. Wolf directs attention to a peculiarity in the form of comet 1910*a*. Besides the main and subsidiary tails, Dr. Wolf's photographs show a conical faint mass of material extending from the base of the coma towards the sun, quite different from anything he has seen in previous comets, and having the appearance of a miniature zodiacal light. The point of the cone was in position-angle 215°, 180° from the direction of the axis of the tail, and was at a distance of 13′ from the nucleus.

Comet 1909*e* (Daniel) was photographed at Heidelberg on February 28, and Dr. Wolf also publishes the latest-determined position of comet 1909*a*, determined from a photograph secured on August 19, 1909, when the comet was fainter than the sixteenth magnitude.

Observations published by Dr. Graff in the same journal show that during January comet 1909*e* was a large nebulous mass, 3′ in diameter, with a nucleus of magnitude 12·5.

OBJECTIVE-PRISM DETERMINATIONS OF RADIAL VELOCITIES.—An ingenious method of determining, approximately, the approach or recession of faint stars is proposed by Prof. Pickering in Circular 154 of the Harvard College Observatory. Various methods have been proposed before, but have not proved remarkably successful. In one of these it was proposed to introduce a standard artificial absorption band in the spectrum of each star, but the didymium and hyponitric acid filter then employed produced bands which were far too wide and hazy for precise measurement.

This difficulty has now been largely removed by Prof. R. W. Wood, who has devised a filter giving an absorption band at λ 4272 which is distinctly more definite than the hydrogen lines in first-type stars. The filter is a weak solution of neodymium chloride, and further experiments are in progress to reduce the thickness of the absorption band by the addition of lanthanum and phosphoric acid. Trial exposures have shown that for ninth-magnitude first-type stars the probable error, at present, is about 10 km., and for eighth-magnitude second-type stars somewhat less; a number of reproductions of the photographs obtained accompany the circular.

Prof. Pickering also enumerates the available objective-prism equipment at Harvard, and states that they are ready to take such photographs as may be desired; further, he invites cooperation from astronomers experienced in radial-velocity work.

ENCKE'S COMET, 1895–1908.—The Monthly Notices for March (vol. lxx., No. 5, p. 429) contains a discussion by Dr. Backlund of the motion, brightness, &c., of Encke's comet during the period 1895–1908. In the first place, he deduces elements fitting the observations of 1895, 1901, and 1904, and shows that the acceleration of the mean motion was not constant during the period under discussion. This leads to a discussion of the various causes which might produce the diminution observed, and of the probable time at which such causes, or cause, were, or was, effective. Excluding solar electrical forces, it seems probable that the resistance encountered is a meteoric swarm in the neighbourhood of perihelion, and the decrease of the acceleration must be attributed rather to the diminution of the density of the resisting medium than to changes in the comet itself. If, however, the variation of the acceleration is held to be actually connected with the maxima of solar activity, tangential electrical forces are admissible in explaining it, and the problem becomes indeterminate.

Various causes of the comet's fluctuations in brightness, *e.g.* an alteration in shape, and therefore in surface presented, produced by the solar tidal action, are discussed, but no explanation is entirely satisfactory, and the question is left open.

Dr. Backlund then investigates the relation between Wolf's comet of 1907 and Encke's comet, and the possibility of capture by Jupiter. Whilst not proving that the comet was captured, he shows the possibility of such capture having taken place within the past 5700 years.

THE SPECTRA OF THE MAJOR PLANETS.—In Bulletin No. 42 of the Lowell Observatory Dr. V. M. Slipher publishes further descriptions and reproductions of the spectra of the major planets. The photographs were taken with plates especially sensitised for the red end of the spectrum, and show a wealth of detail between D and A. Comparative exposures on the south equatorial dark belt and the bright equatorial region of Jupiter indicate no reason for supposing that the darker portions of the planet are those lying the deeper. The spectrum of Saturn is generally similar to that of Jupiter, but there is a strong band in the latter at λ 646 which is absent, or nearly so, in the former; as the others are of the same intensity, this points to the existence of a constituent in Jupiter's atmosphere which is absent in that of Saturn. No trace of the planetary bands is found in the spectra of Saturn's rings, and there is no indication of any atmosphere about the rings.

A comparison of the spectra of the four major planets shows that in Neptune all the bands seen in the other three are intensified, except that at λ 646, which appears to be peculiar to Jupiter. The evidence for hydrogen absorption in the atmospheres of Uranus and Neptune is very slight, and the intensification of C and F is not copied by the hydrogen bands at λλ 4341 and 4102, so far as an ordinary eye examination can determine, so that, at the best, the identity can only be considered probable. Of the other bands photographed scarcely anything is known, but it is shown that the very strong band at λ 619 is not identical with one in the spectra of red stars, as is sometimes stated.

THE INTRINSIC BRILLIANCY OF THE SUN.—In a previous paper Dr. Nordmann estimated that the intrinsic brilliancy of the sun was 319,000 decimal candles per sq. cm. (NATURE, March 3, p. 29), but he now finds that one of his data, owing to an ambiguity in Müller's text, is incorrect. He has, therefore, re-calculated his value, and gives, in No. 13 of the *Comptes rendus* (March 29), 100,500 decimal candles per sq. cm.

THE CARNEGIE INSTITUTION OF WASHINGTON.

THE eighth annual report of the Carnegie Institution of Washington, describing the work of the institution during the year 1909, has now been published. It is a well-illustrated volume of 259 pages, dealing with the work of administration, the investigations carried out under the auspices of the institution, the various publications, the expenditure recommended for 1910, and additional suggestions. Subjoined are extracts from the report of the president of the institution upon the progress of the different scientific departments.

Among the more important events of the year are the completion of the administration building in Washington, the establishment and active operation of the observatory of the department of meridian astrometry in Argentina, the construction and putting into commission of the non-magnetic ship *Carnegie* of the department of terrestrial magnetism, and the inauguration of the project for the publication of an edition of the master-works on international law. Attention is directed to the fact that with these, and with the previously established larger enterprises under way, the accumulated income of the institution has been exhausted, and that there will be no room for further expansion under current income in the immediate future.

In the last annual report a summary statement of the work of the institution up to October 31, 1908, was given. A more detailed study of the scope and geographical range of this work shows that investigations have been carried on under the auspices of the institution in more than thirty different fields of research, and that these investigations have extended to more than forty different countries. The total number of volumes of publications issued directly by the institution is 141, with an aggregate of about 35,000 pages of printed matter. For the larger departments of investigation there are now provided two astronomical observatories, five laboratories, and one ship. A complete list of the equipments of these establishments includes fifty-eight buildings and eight smaller craft in addition to the ship *Carnegie*. The total amount of funds granted for expenditure is 864,000*l*. The total amount expended is 825,900*l*.

At the date of the preceding annual report the department of meridian astrometry was engaged in the construction of a temporary observatory at San Luis, Argentina. The instrumental equipment for this was shipped from the Dudley Observatory, Albany, N.Y., in December, 1908. After safe transportation to San Luis, the constants of the meridian transit, the principal instrument used, were carefully re-determined, proving to the highest order of precision that this instrument suffered no injury in transshipment. With this indispensable preliminary investigation completed, the work of stellar observation was begun in April, 1909, and is now going on at a rapid rate.

The following list shows the departments of investigation to which the larger grants were made by the trustees and the amounts allotted from those grants by the executive committee during the year:—

	£
Department of Botanical Research	6,400
Department of Economics and Sociology ...	3,500
Department of Experimental Evolution... ...	5,800
Department of Historical Research	4,100
Department of Marine Biology	3,000
Department of Meridian Astrometry	6,000
Department of Terrestrial Magnetism	12,000
Department of Terrestrial Magnetism, vessel...	15,000
Geophysical Laboratory	9,000
Horticultural work of Luther Burbank ...	2,000
Nutrition Laboratory	5,000
Solar Observatory	20,800
Division of Publications	900

The various investigations of the botanical research department have been successfully continued during the past year. Among these, the experiments of the director in the production of mutants in plants seem destined to play a fundamental *rôle* in the determination of the absorbing biological question of the derivation of species. Equally important in this same line are the experiments with beetles of Prof. Tower, for which vivaria are now maintained at the Desert Laboratory at Tucson and at the Marine Biological Laboratory at Dry Tortugas, Florida.

The work of the department of experimental evolution presents a double interest in furnishing evidences at once of the evolution of organic forms and of the evolution of a science. The history of biological science, like the history of most sciences in their earlier stages, has been and still is, marred to some extent by heated controversy. But all this is destined to disappear with the rise of biolog[...]

to the plane of quantitative determination. It is on this plane that the department in question is seeking, with capital initial success, to carry on its investigations. The publications of the department already issued are reckoned among the most important of recent contributions in this large field of research.

The work of the geophysical laboratory proceeds by means of some of the most recent methods and appliances of research, and hence its aims and lines of investigation, like those of all new sciences, present to the public more or less of obscurities of interpretation and obstacles to ready appreciation. The researches of the laboratory afford another instance of the normal evolution of a science from the observational and descriptive stage to the higher level of measurement and calculation. That geology and mineralogy will be much advanced by such researches is now recognised and attested by eminent specialists. Indeed, the definitive results already attained by members of the laboratory staff are now finding their way into the elementary as well as into the more technical literature of those sciences. The equipment of the laboratory has received an important addition during the year in apparatus for subjecting materials under observation to high pressures and temperatures, either simultaneously or separately. This apparatus, developed by Dr. A. Ludwig, research associate of the department for the year, will give pressures up to 17,000 atmospheres, or 250,000 lb. per square inch.

The Tortugas laboratory of the department of marine biology is proving highly effective as a centre for research by a wide range of specialists. Eight associate investigators have availed themselves of the opportunities afforded by the department during the past season, and the results of their studies are now in preparation for publication as contributions to science from the laboratory. It is of interest to note the advent of quantitative investigations here as well as elsewhere in the advancing biological sciences.

The apparatus of the nutrition laboratory proves highly effective, and the experiments already made, on pathological as well as normal subjects, fully justify the confident expectations hitherto entertained with respect to this line of research. Many additions have been made during the year to the equipment of the laboratory. Among these are a bed-calorimeter into which a recumbent patient may enter with ease and safety; a portable respiration apparatus which may be applied readily to a patient reclining on a cot while his respiratory action is accurately determined; and an automatic temperature register, which will give a continuous record of temperature changes in the calorimeters to which it is applied.

The achievements already attained in the development of novel methods and effective apparatus for studies of the sun, and the additions to our knowledge of solar physics already made at the solar observatory, not only justify the predictions of its founders, but warrant the anticipation of still more important contributions to astrophysics in the near future. Work of investigation and work of construction have proceeded simultaneously during the year, both at the observatory site on Mount Wilson and at the shops and physical laboratory in Pasadena. The 60-inch equatorial reflecting telescope, the installation of which was completed a year ago, has been tested during the past year and proved to be of unequalled excellence, whether used as a visual or as a photographic instrument. Its optical perfection and its wide range of applicability make it a noteworthy contribution to progress in observational astronomy. The 150-foot tower telescope, authorised by the budget of the current year, is in a forward state of construction, and will soon become one of the most effective units in the telescope battery of the observatory. The discovery of the existence of the Zeeman effect in the sun, announced by the director a year and a half ago, has been confirmed and extended in its application to further interpretation of the nature of sun-spots, as well as to researches into the more recondite electromagnetic properties shown by the sun. Closely connected, apparently, with these properties are the major and minor "magnetic storms" to which the earth's magnetism is subject, now of special interest alike to the staff of the solar observatory and to the staff of the department of terrestrial magnetism. It may suffice here to record only one other item of interest, namely, the failure, thus far, of the manufacturers of glass at St. Gobain, France, to furnish a satisfactory disc for the 100-inch Hooker telescope. The disc reported as *en route* for delivery a year ago proved so defective that it had to be rejected. The manufacturers are still confident, however, that they can meet the requirements, and it is hoped that through the collaboration of Prof. Ritchey, of the observatory staff, who has spent some months at St. Gobain during the year, a satisfactory disc may be ultimately secured.

The field-work of the terrestrial magnetism department has gone forward with dispatch. Surveys have been carried on in fifteen different countries distributed over four different continents. The routes traversed by the observers will give a large aggregate of data from hitherto little-known or unexplored regions. Thus Mr. Sowers has obtained observations at intervals along a route extending from eastern China west across China and Chinese Turkestan, and thence south to Bombay, India; Prof. Beattie, research associate of the department, has completed a survey from Cape Town to Cairo; Mr. Pearson has secured measurements in Persia, Beluchistan, Arabia, Turkey, and Russia; while other observers have been equally active in South America, Central America, and British America.

The publication of sixteen volumes of researches has been authorised by the executive committee during the year at an aggregate estimated cost of 5840*l*.

RECENT WORK OF GEOLOGICAL SURVEYS.[1]

III.—CANADA.

THE Geological Survey Branch of the Canadian Department of Mines continues to issue colour-printed geological maps at an extremely moderate price, as well as numerous mining plans on a large scale. We note that "individual maps or reports will be furnished free to *bona fide* Canadian applicants."

The Mines branch deals in its reports with technical matters relating to ore-deposits, the occurrence of which means so much to the Dominion; but its memoirs cannot be neglected by the geologist. Mr. Fritz Cirkel's report on the chrome iron ore deposits in eastern Quebec (1909) thus contains an interesting account of the serpentines of Canada (p. 12); the chromite occurs in those of Cambrian age, while the earlier serpentines appear, so far, unproductive. The Cambrian serpentines are associated with diorite, and are regarded (p. 18) as alteration-products of an olivine-gabbro. Their non-aluminous character, as shown in the typical analysis given, would lead one to assume that considerable differentiation had gone on in the basic series, and that the serpentine was at one time an olivine rock rather than a gabbro. This is probably the author's view, as stated on p. 87. The chromite is irregularly distributed in pockets, a provoking arrangement for the miner, and reminding one of the occurrences in the Dun Mountain district of New Zealand. This report, with its review of chromite ores in the world at large, is of far more than local value, and the deposits in the Transvaal, so recently described, are well referred to and illustrated. Mr. F. Hille's report, on some iron-ore deposits in Thunder Bay and Rainy River districts, Ontario, dwells on the possibility of using peat-coke, manufactured by the Ziegler process, as a fuel for smelting. Many provinces of Canada are rich in peat, poor in wood, and destitute of coal. The ores dealt with in the report are magnetite and hæmatite, and a magnetic survey has been used in the detection of the former.

The recent reports of the Canadian Geological Survey Branch include one by Mr. W. H. Collins on Gowganda Mining Division, Ontario (1909), with a very large geological map on the scale of one inch to one mile. The district described lies along the Montreal River, west of the Quebec border, and is being invaded by a rush of prospectors, owing to the discovery of silver cobalt ores similar to those that have made the reputation of Cobalt. The valuable veins occupy large fissures in quartz-diabase, which is intrusive in Huronian sediments. The author traces a magmatic gradation from the diabase into an aplite intimately associated with it (p. 33). The illustra-

[1] The second article appeared in NATURE of February 10.

tions show well the physical characters of this forest-clad region, which, with its lakes, rivers, and low hills, is, indeed, typical of the pre-Cambrian lands of North America.

Mr. Collins also reports on the "Region lying North of Lake Superior between the Pic and Nipigon Rivers, Ontario" (1909), where he was again on the great Archæan peneplain. The soils, still so deficient on this recently glaciated surface, fill the river-valleys and depressions, and "form a thin, discontinuous blanket that ineffectually covers the underlying Archæan floor." Mr. W. J. Wilson's report on parts of Algoma and Thunder Bay districts, Ontario, is bound up with that by Mr. Collins, and covers the river-courses of the country to the north and east. The large map illustrating both papers, on the scale of eight miles to one inch, together with the photographic illustrations, shows how exploration must for a long time be confined to the natural channels through the woodlands. Fossiliferous beds of Silurian age have been found on the tributaries running from the south and west into the Albany River. Their fauna is described by Mr. Whiteaves in an appendix (p. 34), and the report, with characteristic Canadian foresight, also illustrates the modern fauna in the form of speckled trout and store-clad Indians.

Mr. O. E. Leroy writes on the "Main Coast of British Columbia and Adjacent Islands in New Westminster and Nanaimo Districts" (1908), where he has a fascinating field among the fjords north-west of Vancouver. The drainage-grooves now entered by the sea are believed to have originated in early Cretaceous times, when great erosion prevailed. The country has been modified by local glaciation and by the passage of the lobe of an ice-sheet down the Strait of Georgia, inside Vancouver Island. A great batholite, varying in composition from a granite to a gabbro, invaded the Palæozoic sediments and igneous series, probably in the Upper Jurassic epoch, and has left conspicuous traces of its gradual advance by "stoping" (p. 17). This mass is responsible for a large part of the steep and rocky scenery along the fiords. The country appears rich in lead and copper ores, and magnetite awaits further development on Texada Island. The coal on Vancouver Island and the limestone on Texada Island are suggested as local means of smelting.

Mr. D. D. Cairnes's report on part of the Conrad and Whitehorse mining districts (1908) gives impressive illustrations of the grim scenery of Yukon. Aërial tramways now bring up fuel and food to claims on Alpine ridges, and the telephone prevents the feeling of isolation which tends to grow on pioneers. Conrad City is so young that it does not appear on the contoured map constructed in 1906, but we understand it to be at the foot of the Montana tramway. A photograph of it, facing the huge mountain-wall across the lake, assures us of its reality. As usual, the best is made of everything, and we are told that the long summer days may be delightful, although the lake waters remain so cold as to threaten death to those immersed in them. The gold-mining is in vein-quartz traversing Palæozoic schists, as in the Klondike fields. The granite that is so conspicuous on the coast of British Columbia cuts these schists, and is overlain by porphyrites and the Lower Cretaceous Tutshi series. A post-glacial eruption (p. 37) of considerable magnitude has formed a layer of volcanic ash 3 to 6 inches thick over a wide area in the valley-floors.

The Canadian Survey is not entirely absorbed by the excitements of mining enterprise. Dr. D. P. Penhallow, in a handsome quarto, reports on the Tertiary plants of British Columbia. This includes a review of all the known species, conveniently arranged alphabetically under genera, which are also in alphabetical order. The basis of the present work is an extensive series of plant-remains collected by Mr. L. M. Lambe for the Survey in 1906. East of the Rocky Mountains, the Canadian lignites are of "Laramie" (Eocene) age, though they have been referred by Heer, as was his general practice, to the Miocene. Similarly, the "Miocene" lignites of British Columbia are shown, by Dr. Penhallow's analysis of species, to be partly of Laramie and largely of Oligocene age. Sir William Dawson's views have thus been verified in detail. The table on p. 152 will be useful to stratigraphers.

Part iv. of the third volume of "Contributions to Canadian Palæontology" is by Mr. Lambe, on the Vertebrata of th Oligocene of the Cypress Hills, Saskatchewan. This a continuation and revision of a previous work by Cop and describes several new species, including *Amia exil* and *Lepidosteus longus* among fishes, represented by fra mental remains, a probable anthracotherian tooth, ar the well-preserved lower jaw of a Titanothere, *Megaceroj primitivus*. Eight excellent plates, from the author's drav ings, accompany the memoir.

G. A. J. C.

PAPERS ON AMERICAN INVERTEBRATE

NOS. 1706, 1710, 1712, and 1713 of the Proceedings the U.S. National Museum are devoted to the descri tions of various groups of invertebrates from America territory. In No. 1713 Mr. S. S. Berry deals with a seri of new cephalopods from the Hawaiian Islands, amor which special interest attaches to the new genus and speci *Stephanoteuthis hawaiiensis*, an apparent member of th Sepiolidæ, characterised by the peculiar shape of the boc and the ventral anterior extension of the mantle to cov the funnel. In other respects the genus is, however, r lated to Heteroteuthis. A remarkable globular form, d scribed as *Cranchia globula*, is related to *C. reinhardti*, which globularity appears to be a feature of immaturit but whether the same holds good for the new form—i indeed, it be really distinct—remains for future determina tion.

Cœlenterates from Labrador and Newfoundland form th subject of No. 1706. These have been investigated by M H. B. Bigelow, who finds that all of them belong previously described species, so that their interest is large geographical. Several of them have been hitherto know only from Greenland and northern Europe. The speci *Catablema vesicaria* and *Æginopsis laurentii* have, how ever, proved of interest from an anatomical point of view and are important in regard to the classification of th Narcomedusæ.

In No. 1710 Mr. E. B. Williamson revises the arrang ment of the North American dragon-flies of the genu Macromia, from which he finds those described a Epopthalmia to be inseparable. Didymops, as regard venation, appears to come very close to Macromia, but ma seemingly be distinguished by other characters. Two ne species of the genus under review are named and described

No. 1712 is devoted to the second part of Dr. N. Annan dale's account of the fresh-water sponges in the collectio of the U.S. National Museum, none of the few form referred to being new to science.

EDUCATION IN ENGLAND AND ABROAD.[1]

FROM the eighth century to the time of the Reformatic the history of education in England, France, ar Germany was in many respects similar. The one champic of learning was the Church; and in the religious hous we find an organised and established system of educatio of which not only the lower rank of people, who cou not pay for their learning, but noblemen and gentlemen sons might take advantage. In England the system wa particularly successful; as early as the year 1201 there a said to have been more than 3000 scholars at the Ur versity of Oxford, and Roger Bacon tells us that the never had been so great an appearance of learning a so great an application to study as at that time, wh schools were erected in every city, town, and boroug The learning of Englishmen compared favourably at th early date with that of scholars on the Continent. We a told that in 1169 there was a "colony" of English studen at the University of Paris, belonging to the faculty of art of which it is said that they "in particular were numerous that they occupied several schools or colleges, a made so distinguished a figure by their genius and lear ing, as well as by their generous manner of living, th they attracted the notice of all strangers."

Against the Church, in this matter of education, we arrayed both the general opinion of the aristocratic class and also the power of the law. Not all the sons of gentl

[1] From a paper read at the North of England Education Conferen Leeds, on January 8, by Otto Siepmann.

men were left in utter ignorance. Younger sons gave themselves with increasing frequency to the studies of good learning, though those who inherited their fathers' estates were usually of the familiar type. The daughters of the upper classes were not infrequently educated by the Church, but the fact remains that the provision made for education in religious houses, and in the grammar schools that were founded in the twelfth century, was in the main intended for the poor citizen's and ploughman's children. Winchester (founded in 1373) was probably the only school that did anything before 1450 for the education of the gentry. Even there the number of poor to paying scholars was as seven to one.

Yet England was, so far as education is concerned, the leading nation of Europe at this time. Progress was steady, and the respect for learning, starting among the lower classes, gradually forced its way upwards. The revival of learning in Italy, and in Europe generally, facilitated the progress of education in England, and disposed of the contempt originally felt for scholarship by the aristocracy; but while the introduction of the study of Greek enhanced the value of education, the recognition of literary culture by the upper classes of society began to make it the privilege of the rich, to the exclusion of the poorer scholars, whose monopoly it had originally been. The great principle upon which the Church had built up its system was abandoned. Rich men's sons were turning poor men out of the endowments meant only for the poor. "*Les gros poissons mangent les menus.*" "Poore men are supplanted by the rich, the weake by the strong, the meane by the mighty."

But the fatal event was the dissolution of the monasteries, and the final destruction of the Church's system of education, which had raised Englishmen to a height of culture to which the other nations of Europe could not attain. The effects were immediate and disastrous; by one blow the whole English educational system was crippled and almost destroyed; until the end of the nineteenth century the effects of that fatal step were still felt, and it is only recently that efforts have been made to reorganise and restore what at that time was destroyed.

The Reformation, which was the ultimate cause of the downfall of the English system of education, was in Germany the decisive influence which led to the establishing of education upon a broad and stable basis. Up to that time education had been dominated by the Church, and had existed, in the first place, for the Church, and the results had not been so satisfactory as in England. Since then the State, the municipal authorities, and, above all, the parents, have taken an ever-increasing interest in the education of children.

The leader of this great movement was Martin Luther. In his "Epistle to the Burgomasters and Councillors of Sundry Cities in German Lands," written in 1524, he declared it to be the duty of cities, and of secular authorities in general, to provide good schools and to encourage attendance; and, at a later date (1530), in his "discourse on the duty of keeping children at school," he urged the authorities, even, if necessary, at the public expense and with the aid of compulsory measures, to draw clever boys to the pursuit of learning in order to provide competent men to fill the public offices.

The outcome of this movement in favour of general education for all, and the pursuit of advanced studies by gifted scholars, is to be seen in the foundation of a large number of grammar schools, in the reform of the universities, and in the establishment of elementary schools in which reading, writing, catechism, and singing were taught.

In spite of various set-backs, such as the thirty years' war, this system of education survived in its main outlines until the end of the eighteenth century. In the nineteenth century it was developed by the introduction of modern sciences, modern languages, and their literatures, as compulsory subjects in secondary schools, and by their admission into the curriculum of the universities; but the present system in Germany has evolved, under the combined influences of Humanism and the Reformation, from that which was established as a result of Martin Luther's movement.

The importance of France in the history of education is mainly confined to its influence upon higher education. The failure of the Reformation left the educational system of the Church very much as it was; but in university education France took a leading position in the Middle Ages. The University of Paris, which attracted, even in the twelfth century, many students from all countries in Europe, became the prototype of German universities founded in the following century; but elementary education in that country has remained in a deplorable condition. In 1866 24 per cent. of the recruits could neither read nor write, and twenty years later a similar percentage of those who were married were unable to sign the register.

The new era in the political, economic, and educational history of the world may be said to begin with the year 1870. The history of education in the three countries since that date is so familiar to you that I may proceed at once to the present state of affairs, first of all in Germany. In elementary education Germany had a start of more than a century as compared with England. For rich and poor alike attendance at the elementary school had been compulsory in every German State for more than a hundred years before the Forster Act became law. The system is of long standing, and experience has shown that the organisation and working of the arrangement are practically perfect.

The curriculum in German elementary schools is of the simplest. Originally the three R's, religious knowledge, and singing were the only subjects taught; to these have been added at various times the elements of geography and history to stimulate interest and encourage patriotism, and, for pupils of the upper standards, a certain amount of natural history. The compulsory school age is from six to fourteen, and although there is some diversity in the excellence of the school buildings, they are, for the most part, airy and good.

In Germany the State does not exist for the individual: the individual exists for the State, and the State considers that it is to its own advantage to have, above all things, a high average level of knowledge and ability. This the Germans have certainly succeeded in attaining in elementary education, and it is in this high average that their great superiority in elementary education consists.

Let us now turn to the German secondary schools. The organisation is as complete as in the case of elementary schools, and the principle is again the same. Individual prominence must be sacrificed to raise the common average: and to this must be added another principle, equally important and similar in its effects, that all subjects are taught in form; this applies to every school and to every boy from the first to the last day of his career.

The education of a boy in secondary schools may proceed upon any one of three lines. It may be classical, semi-classical, or modern. For centuries Germany clung to a belief in the classical system for higher schools, but the force of circumstances eventually necessitated the formation of two new types of school, each designed to give a liberal education of a different kind. Yet the classical Gymnasium still holds its own (although there is no longer any very close attention paid to composition in Latin and Greek), for in 1908, of the freshmen who matriculated at Prussian universities, 77 per cent. came from Gymnasien, or classical schools.

The Realgymnasium, or semi-classical school, is differentiated from the Gymnasium by the fact that, while Greek is not taught at all, modern languages, mathematics, and science receive greater attention. The Oberrealschule is purely modern in its curriculum, and excludes both Latin and Greek. All three types have a nine years' course, usually begun at the age of ten, preceded by three or four years at an elementary or preparatory school, which is often attached to the college. All these schools are established by the State or by the State in conjunction with the municipality; their fees range between 5*l.* and 6*l.* per annum.

There are some to whom the principle upon which these schools are founded will appear to be radically false, however good may be the discipline and the organisation in its execution. As the main intention is to make it possible for a high percentage of the pupils to pass the leaving examination, practically the whole form has to be pro-

moted from one stage to the next, and the amount of work set for the form to master has to be small enough to be done by some of the more stupid boys in the given time. The inevitable result is that the ablest boys mark time from first to last throughout their school career. They have a year to do work which they could do in half the time, so that their powers are never developed by sustained or strenuous effort.

Individual excellence is sacrificed in yet another way, according to the second guiding principle of secondary education stated above. Since all subjects are done in form, a particular aptitude for a special subject is never developed at school. Our best boys in any given subject attain a far higher standard before they leave school than is possible in Germany. Yet by preventing the possibility of specialisation at school the German system ensures for every boy a sound general education. Every boy is compelled to take all subjects prescribed by the syllabus of his school. Only recently, and in isolated cases, has this rule been remitted in the highest forms by way of experiment.

At the university all this is changed. There is no prescribed course of studies of any kind, and no compulsory attendance. The German student enjoys almost complete liberty, both as regards his studies and his behaviour. Yet in the majority of cases he makes good use of his time, partly because his allowance will not admit of any vast extravagance, partly because his position in life frequently depends upon his passing the final examination, but chiefly, I think, because those Germans who go to the universities do so, for the most part, because they have pronounced and genuine intellectual interests. The freedom which they are allowed in the choice of their subjects, and the general lack of supervision and of interim examinations, react favourably upon the results of their work. They carry into life an active interest in some branch of knowledge, which they frequently pursue as long as they live.

The German Government is convinced that education will be the determining factor in the future of the nation. In 1908 the Prussian Minister of Education framed a whole new scheme of regulations intended to prevent mechanical learning and routine work, to foster self-reliance and personal initiative in the pupils of the elementary schools. Observation is to be encouraged in open-air lessons and expeditions, and the children are to learn something of the working of commerce in modern times, of the means of transport, and of Germany's colonial activity; and in continuation schools commercial education is being put within the reach of an ever-increasing number of students. In 1907 there were, moreover, 1600 industrial continuation schools for boys, and 50,000 students were working at rural continuation schools as compared with 8000 twenty years before. The State contribution for industrial continuation schools has been increased 100 per cent. since 1901.

Besides all this there has been a remarkable increase in Realschulen and Höhere Bürgerschulen with a six years' course, of which Prof. Sadler has given such a flattering account in special reports. In the technical colleges of university rank the increase in the number of students is almost as striking. Mention should also be made of the National Chemical Laboratory, for which a fund of a million marks is to be raised. The Prussian Government has offered a site for the building free of cost, and the results of its erection should be of world-wide importance. New academies of commerce have sprung up at Cologne, Frankfort, and elsewhere, and the Hamburg Colonial Institute is to be made into an establishment of university standard for those who intend to give their lives to colonial enterprise.

On turning to France we find, in a minor degree, two of the prominent characteristics which we noted in German education, first, a profound sense of the unique importance of education, and a serious effort in recent years to improve the existing system; secondly, that genuine intellectual interest which is imparted to pupils in the secondary schools.

As in pre-Reformation days, France is chiefly distinguished for its secondary and university education. *Primary education* is still in a lamentable condition, for the law of 1882, which made it compulsory, is practically a dead letter. Of four and a half million pupils, nearl one million were recently found not to be in attendanc on a given day. The percentage of illiterates is even no increasing. M. Steeg, the chairman of the Budget Com mittee, in submitting the estimates for 1909, said:— "While in Germany and Switzerland there is not on illiterate in 200 inhabitants, in France, out of every hundre young men, four or five cannot read, and out of ever hundred young women six or seven are absolutel illiterate." As a matter of fact (according to the Hand wörterbuch für Staatswissenschaften of 1908), the numbe of illiterates in Germany was two in every ten thousan recruits, in France 400, while in England 300 out every 10,000 people married were unable to sign th register. The alarm caused by the increasing illiteracy i France has led to severe criticism of the methods and scop of the instruction in primary schools. The main fau found with the official course of instruction is that it too ambitious. *The higher primary schools*, intended f children between the ages of twelve and fifteen, are mor satisfactory in their results, but they are few in numbe There are also practical schools of commerce and industry of which there were sixty in 1907, but they interfere wit the general education of the children by taking them f practical training at the early age of twelve. Priva enterprise has in recent years provided continuation school at which there were in 1907 half a million adult attendant and these are at the present moment under the considera tion of the French Government. The so-called *universit populaires*, for the spread of political and social theorie are on the decline.

Secondary education comprises the Lycées established b the State in conjunction with the municipalities, and th Collèges established by the *communities*. Following preparatory course of two years, the Lycée course prop is divided into two cycles; the lower cycle covers fou years, and comprises a classical course and a non-classic course; the upper cycle comprises three years. The pr gramme for the first two of the three years is arranged four parallel courses, as follows:—(*a*) classical cours (*b*) Latin and modern languages; (*c*) Latin and science (*d*) sciences and modern languages. Following these tw years is the class of philosophy and mathematics, each si comprising a classical and a non-classical section. Th bachelor's diploma is awarded to students who comple either of the full secondary courses of instruction and pa the degree examination.

As regards universities in France, that of Paris stan out with great prominence. It is richly endowed, an receives from the State nearly five million francs p annum. It is a vast and excellent institution for teachi and research. Its library consists of about 580,0 volumes, and the most eminent scholars of the country a among its professors. In January of last year there we 16,935 students attending this great University, while t fourteen provincial universities were attended by on 18,000 students, and their income proper amounted to n more than two and a half million francs, besides tw million francs from loans; but it is to be expected that t provincial universities in France will have a prospero future before them, since the energy displayed in the and the work done by professors and students are of high order.

Besides the universities, France possesses several spec schools of university rank, all of which enjoy a gre reputation, among them the Collège de France, the Éc Pratique des Hautes Études, the École Nationale Chartes, and the School for Oriental Languages.

Impartial judgment of the French system of educati reveals a great deal that is excellent, especially in seconda schools and at the universities. The progress made sin 1872 is very considerable, though much yet remains to done.

If the study of educational systems prevailing abroad of special interest to us at the present time, it is becau England's attention has been attracted by the commerc and industrial success of other nations which have lo since held the conviction expressed by Signor Luzzatti the scientific congress at Padua in September last in th words:—"The fate of nations is nowadays decided in th secondary schools." The belief that there may be so

truth in this bold assertion has rapidly gained ground among Englishmen who have the welfare of the nation at heart, and those who are directly interested in the severe competition in trade and commerce that has come with the enormous advances made by Germany and the United States in industrial and commercial enterprise. Although there are probably still a large number of Englishmen who have their doubts about this magic power of education, the experience of the last forty years and the revelations that have been made about other countries, together with the fact that foreign competition is felt to become a little uncomfortable, have made this educational question sufficiently urgent for the Government to take the matter in hand, and as a result we have a large department of the Government with a responsible Minister of Education at its head, and a most active Permanent Secretary, all hard at work to set our house in order.

The schools we require are (1) an elementary school with a modest and simple curriculum; (2) a municipal or county secondary school of the type of the German Realschule with leaving age sixteen, in which French, German, and English, elementary mathematics, and elementary science form the staple of education; (3) a modern school with leaving age nineteen, in which the same subjects are taught, but carried further, and in which Latin should be an alternative to one of the foreign languages; (4) a classical school, in which Greek, Latin, and English form the backbone of the teaching, and mathematics, science, French, and German hold a subordinate place. This type of school would naturally be one for the abler boys, for they alone can reap the full benefit of such a wide course, but I am convinced that they can cope with it successfully; those who cannot do so should be rigidly kept out of it. Boys of the modern and the classical school should be admitted to the universities after having passed through the top form and after passing a leaving certificate examination in the subjects of their curriculum. Scholars from the elementary school should pass on to the municipal or county or modern school at the age of ten, and there should be attached to the elementary school a technical or industrial department for boys who are apprenticed to a trade, which they should attend for two years—from fourteen to sixteen—as part of their period of apprenticeship. Such a school has recently been opened by the London County Council as a day technical school for boys in book production (printing, book-binding, &c.). A similar department might be attached to municipal or county schools for boys from sixteen to eighteen, in which, according to the locality, agricultural, commercial, or industrial subjects of a practical nature should be taught.

You may think that these ideas are Utopian; I do not; in fact, I am convinced that if the nation has the will the authorities will find the way, and, though it be a costly enterprise, I venture to say that England never made a better investment, not even in Dreadnoughts.

"Caveant consules ne quid detrimenti capiat res publica."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The ordinary course of instruction given by Captain Lyons, F.R.S., lecturer in geography, has proved so successful that a higher or second-year course has been instituted in addition, with the approval of the Senate and Court of the University.

The annual meeting of the Institute of Metals will be held in Glasgow on September 21 and 22 in the natural philosophy building, which has been granted for the purpose by the University Court.

The principal has received intimation of a gift of 5000*l.* for the general fund of the University from the trustees of the late Alexander Fleming; and of a grant of 2000*l.* for the provision of additional lecturers and assistants in the faculty of arts from the committee for the better equipment of the University.

The first sod on the site of the buildings in Kelvingrove Park for the Scottish Exhibition of National History, Art, and Industry, 1911, was cut by Lord Tullibardine on April 22. The promoters of the exhibition have promised to present to the University a sum of 15,000*l.* from the profits for the foundation of a chair of Scottish history and literature. Meanwhile, Sir Herbert Maxwell, F.R.S., and Dr. William Wallace have been appointed university lecturers in Scottish history and Scottish literature respectively.

At the graduation on April 18 six graduates received the degree of D.Sc. for original research. One was a lady and one a Japanese naval architect. Thirty-one candidates were admitted to the degree of B.Sc.

Sir William MacGregor, who is a medical graduate of Glasgow, has been requested to represent the Senate at the semi-jubilee of the foundation of the Royal Geographical Society of Australasia, to be celebrated at Brisbane in June.

MR. J. A. SMITH has been elected to the Waynflete chair of moral and metaphysical philosophy in the University of Oxford, in succession to Prof. T. Case, who resigned last term.

THE committee of the Central Bureau for the International Interchange of Students (of which Lord Strathcona is the president and Lord Brassey the treasurer) has opened an office in Caxton House, Westminster, to facilitate educational travel for all university men, graduates or otherwise, with the view of assisting them to gain a first-hand knowledge of the life, needs, progress, and potentialities of other English-speaking countries. Travelling scholarships for undergraduates are being raised at nearly all the universities. They will be tenable this summer, and will provide a valuable educational tour of a practical character through Canada and the United States for students whose return to their own universities will allow for the dissemination of their widened outlook and inspiration among their contemporaries. Already a few of the scholarships are completed. The scholarship tours are intended to be of great educational interest, and to illustrate the more important spheres of activity—administration, the scheme of education, industry, social work, &c. The places at which stops will be made are chosen accordingly. Private persons who are prepared to conform to the rules made to govern the tours, and to defray their own expenses, will be allowed to join these tours. A number of university men, both staff and students, as well as non-resident graduates, are arranging to travel independently under the auspices of the bureau, which freely provides them with introductions, information relating to places offering the best facilities for the study of a given subject, and special rates of travel. The bureau aims at being a clearing house of information on education of a practical kind for students throughout the world; and among its more immediate objects are the promotion of a standardisation of work among the universities which would enable a student to take a part of his course in another university than his first Alma Mater. It desires to encourage a greater exchange for post-graduate work. The expenses of organising and conducting the scholarship tours are not inconsiderable, and further donations are needed. They should be sent to Lord Brassey. A sum of 1000*l.* has been offered conditionally on a further 6000*l.* being forthcoming. The various sums raised for scholarships will count towards this total, but donations to the central fund are necessary to enable the work to be effectually carried on. Further information will be readily given on application to the honorary secretary, Mr. H. W. Crees, at Caxton House.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 14.—Sir Archibald Geikie, K.C.B., president, in the chair.—E. N. da C. **Andrade**: The viscous flow in metals, and allied phenomena. These experiments on the flow of metals were carried out on wires, which were subjected to a continued constant stress. The increase of stress which takes place owing to thinning if the wire is stretched by a constant load was avoided by having the stretching weights made in the form of hyperbolæ of revolution, and letting them sink into water as the wire lengthened; the size of such a weight can be chosen so as to keep the load per unit area of cross-

section constant. The metals treated were lead and a lead-tin alloy; the general nature of the results was the same in both cases. When suitably loaded there is a rapid initial flow which gradually settles down to a steady flow, for which the rate per unit length of wire flowing is constant right up to breaking. Throughout the experimental range the extension can be represented closely by the formula

$$l = l_0(1+\beta t^{\frac{1}{3}})e^{\kappa t}.$$

β is taken as a measure of the more rapid initial flow, which we call the β flow; κ as a measure of the coefficient of viscous traction. The curves κ/(stress) against stress are hyperbolæ with one asymptote parallel to, one steeply inclined to, the axis of stress. β tends to become constant as stress increases; for a series of experiments on lead done at 160° C. β tends to the same constant value as for the series done at room temperature. This supports the suggestion that β measures a definite physical effect, dependent on some geometrical structure. For the alloy the β flow is relatively very small.—Clive **Cuthbertson** and Maude **Cuthbertson**: The refraction and dispersion of argon, and re-determinations of the dispersion of helium, neon, krypton, and xenon. The refractive index of argon has been determined for seven points in the spectrum with improved apparatus, and careful re-determinations have been made of the dispersion of the other four inert gases in order to bring them all up to the same level of accuracy. The refractivities are expressed in the form

$$\mu - 1 = C/(n_0^2 - n^2),$$

and the constants of these equations, calculated from the observations by the method of least squares, are shown in the following table:—

Element	$C \times 10^{-27}$	$n_0^2 \times 10^{-27}$
Helium	2·42476 ...	34991·7
Neon	5·18652 ...	38916·2
Argon	9·43264 ...	17008·9
Krypton	10·6893 ...	12767·9
Xenon	12·2418 ...	8977·9

The values of the refractivities derived from these equations generally agree with those found experimentally to one or two points in the fifth significant figure. It is satisfactory to find that the values of n_0^2 now obtained by these more accurate measurements do not differ by more than 2 per cent. from those published by the authors last September.—Dr. J. O. Wakelin **Barratt**: The action of the radiation from radium bromide upon the skin of the ear of the rabbit. The ear of the rabbit was exposed to the action of the radiation from 1 mg. of radium bromide spread over a circular area of 7 mm. diameter, and the resulting pigmentation of the skin was studied. It was found that pigment was deposited most abundantly opposite the edge of the disc of radium salt. The deposit, when viewed under a low magnification, presented a characteristic reticular appearance. The larger spaces enclosed by the pigment, which were more or less polygonal, contained hair follicle groups, but the smaller spaces were free from hair follicles. A certain amount of pigment was also deposited in a diffuse manner, chiefly opposite, or a little outside, the edge of the disc. This, when marked, caused the reticular pattern to be somewhat obscured. The deposit of pigment was not quite uniform, but tended to take on a punctate character. Opposite the centre of the disc of radium salt a varying degree of depigmentation occurred, though at the same time here and there a small amount of pigment, arranged in an imperfect reticular pattern, could sometimes be recognised. The pigmentation was chiefly in the epidermis, the cutis vera being less affected. The depigmentation also affected both epidermis and cutis vera, but was, however, more striking in the latter than in the former. No change in the pigmentation of the hair shafts was observed. In a white rabbit the pupils of which presented a red reflex, prolonged exposure to the action of radium bromide caused the appearance of an exceedingly slight reticular deposit opposite the applicator. With this exception, all the rabbits employed had black or mixed black and white coats. Attempts were made to obtain pigmentation by the action of radium upon human skin, but were not successful.—Prof. Silvanus P. **Thompson**: A physiological effect of an alternating magnetic field. If in a darkened room, or with eyes closed, the head is placed in an alternating magnetic field of sufficient intensity, there is perceived over the whole region of vision a faint flickering illumination, colourless or of a slightly blue tint. The period of the flicker is not well defined. It does not seem to be the same over the whole field of vision at the same time, nor is it equally bright over the whole field of vision. Even in daylight, with the eyes open, one is conscious of a sensation of flicker superposed on the ordinary vision. It has not yet been definitely ascertained whether there is any relation between the direction of the axis of the field with respect to the position of the skull. No after-effects of any kind have been observed. The alternating magnetic field, the intensity of which (quadratic mean) was about 1000 C.G.S. units, was produced by sending a current of about 180 amperes through a coil of thirty-two turns formed into cylindrical form about 9 inches in internal diameter, the current having a frequency of fifty periods per second. No effect on the senses of smell, taste, or hearing has been observed. (Added April 14, 1910.—Several of the observers have noticed a sensation of taste after two or three minutes in the alternating magnetic field.)

Faraday Society, April 5.—Dr. J. C. Cain in the chair.—W. P. **Dreaper**: Nature of the action of dyeing. The abnormal reactions obtaining in the case of "ingrain" colours when the dye was produced *in situ*, as compared with the same dyeing effect when the same dyes are applied as direct dyes in relation to their subsequent resistance to resolution into solvents; the variations in the rate of fading of picric acid on different fibres under the influence of dehydrating reagents acting through a vacuum as compared with the equivalent action on the acid itself; the abnormal reactions obtained when the dyes of the indicator class (*e.g.* methyl orange) are subjected to the action of acids in the presence of fibre substances; the variations in resolution of the dyes from the fibres brought about by differences in temperature of dyeing; all these were, it was claimed, proof as to the important influence of certain factors in determining the fixing power of the fibres for dyes, this varying as the conditions of dyeing. It was also pointed out that the dyes were definitely fixed in some way on animal fibres, so that they might even resist the subsequent action of acids, as proved by these colour changes.—Prof. W. W. Haldane **Gee** and W. **Harrison**: The electrical theory of dyeing. The literature relating to the causes of dyeing reveals great differences of opinion as to the physical and chemical phenomena involved. The basis of the electrical theory is that when any two bodies are placed in contact they are oppositely electrified. In the case of tinctorial chemistry, one of the bodies is a non-conducting solid and the other a liquid. There does not seem to be any direct method of obtaining the value of the potential difference between such bodies. The authors avail themselves of the classic theory of von Helmholtz, which enables the potential difference between a liquid and a porous diaphragm to be deduced. They have determined the nature of the charge on the particles in suspension and in colloidal solution, and find that in water all basic substances are positive, the hydrochlorides of basic dyes positive, all acid substances negative, and most neutral substances negative. They find the speed of the particles under electrical stress to be of the order 20×10^{-5} cm. per second, per volt, per cm. Negatively charged particles attain their maximum speed at about 40° C. By measuring the difference of electrical pressure between the two sides of a diaphragm when the liquid is filtered under mechanical pressure, the authors find the approximate value of the contact difference between fibres and water to be:—cotton, 0·06 volt; silk, 0·22 volt; wool, 0·90 volt. The influence of temperature shows a maximum charge at about 40° C., and a minimum at about 80° C.

Linnean Society, April 7.—Dr. D. H. Scott, F.R.S., president, in the chair, succeeded by Mr. H. W. Monckton, treasurer and vice-president.—A. **Henry**: Elm seedlings showing Mendelian results. There are but two species of elm in Britain, *Ulmus montana*, With., and *U. glabra*, Mill.; both are known in the east of England as "Wych-elm." There are, in addition, many so-called varieties, the most remarkable being the "English elm" of British botanists and foresters, confined to the south of England,

nd styled *U. campestris*; this tree is unknown on the 'ontinent. The "Huntingdon elm" he regarded as a ybrid, the first cross between the two species cited. The revious year had been noteworthy for the profuse fruiting f every kind of elm in England, due to the fine autumn f 1908 and the abnormal amount of sunshine during the pring of 1909. The author had procured abundance of eeds of numerous varieties and forms, and from many ocalities. These had been sown, and their progeny nalysed. It was shown that the plants thus arising conormed very closely to the Mendelian formula of 9 : 3 : 3 : 1. 'he author gave, in confirmation of his views, the experince he had with regard to the black Italian poplar, *'opulus nigra × deltoidea*, the cricket-bat willow, *Salix lba × fragilis*, and the Luccombe oak, *Quercus Cerris × uber*, namely, that the offspring of a first cross invariably roduced a crop of the most diverse character, and this nduced the author to formulate his view, that when otanists were unable to agree about the forms of a given lant, it was due to a mixture of at least two species, ut where there was practical unanimity, as with varieties f beech and ash, there was only one species concerned, nd the varieties were due to individual peculiarities. He nally insisted upon the importance of planting trees of a rst cross, on account of their abnormal luxuriance and apid growth, and their producing timber far more quickly han either parent.—F. **Chapman**: The Foraminifera and)stracoda from soundings, chiefly deep water, collected ound Funafuti by H.M.S. *Penguin*.

Physical Society, April 8.—Prof. H. L. Callendar F.R.S., president, in the chair.—B. S. **Cohen**: Demontration of telephone currents in loaded and unloaded nes. The demonstration showed the relationship between he sent and received currents in telephone lines under the 'arious conditions which occur in practice. By the aid of Prof. Kennelly's formulæ it is possible to calculate the elationship between the sent and received currents under iny conditions met with in practice, and for some of the onditions used in the demonstration the calculated results iad been obtained. Four essentials were necessary for the experiments shown:—(1) A current comparable to the ictual telephonic speech current. This was obtained from i vibrating wire interrupter giving a wave with a fundanental of about 100 ~ per second with a damped oscillaion of about 800 ~ per second superimposed. (2) A elephone line with or without its load in the shape of nductance coils. (3) Terminal apparatus. The lines were erminated by receivers and induction coils as used in ractice for what is known as local battery working. 4) Current measurers. For this purpose barretters arranged is alternating-current ammeters were used. The first experiment showed the relationship between the received ind sent current for various lengths of standard cable unoaded. The second experiment illustrated the variation in he current sent when the receiving end was open or closed ircuited and the length of cable was varied. The third experiment showed the current distribution along the oaded cable by inserting a barretter at different points long the cable. The author gave explanations of the 'arious phenomena illustrated in the experiments. He ointed out that it is now possible to make both calculaions and quantitative telephonic tests which give mutual onfirmation.

Paris.

Academy of Sciences, April 11.—M. Émile Picard in the hair.—G. **Bratu**: Certain non-linear integral equations. —Paul **Lévy**: Non-linear integral equations.—B. **Galitine**: The vibration of buildings. Gas engines, not perectly balanced, and running at a high velocity, have been ound to set up vibrations in the surrounding buildings which were not only unpleasant to the inhabitants, but ;ave rise to dangerous cracks in the masonry. The rdinary seismograph is not suitable for studying this class f vibration, so that an instrument has been specially lesigned for this purpose. A description of the instrunent is given, and the theory of its working.—M. **Dussaud**: Sources of light with reduced surfaces mployed normally or obliquely. Movable sources of light. Practical applications.—F. **Charron**: The lubricating iction of air in the friction of solids. Friction in a vacuum. An apparatus is described capable of measuring the critical speed at which the friction of two surfaces is a minimum. By placing the apparatus in a vacuum it was shown that, as the pressure of the air was reduced, the friction varied less and less with the speed. At a pressure of 1 mm. the friction was nearly independent of the speed. —E. **Haudié**: The general law relating to a generator or a receiver with a derived branch: the case of dynamos. —C. E. **Guye** and A. **Tscherniavski**: The measurement of very high potentials by means of an electrometer under pressure. By placing the electrometer in air under a pressure of four to nine atmospheres, the errors due to the silent or brush discharge and electric breeze were suppressed. The constant of the apparatus was nearly independent of the pressure of the gas, and the damping was easily under control. A potential of 80,000 volts from a Wimshurst machine was readily measured with this arrangement.—G. **Urbain**: The magneto-chemical analysis of the rare earths. The magnetisation coefficients vary more rapidly than the atomic weights in the rare earths, and the measurements are much more easily made. The results of the application of the method to the separation of a mixture of dysprosium and yttrium are given.—W. **Louguinine**: The determination of the quantities of heat disengaged during the addition of bromine to some unsaturated substances. Data are given for the heat of combination of bromine with caprylene, styrolene, cyclohexane, ethyl phenylpropiolate, and pulegone.—E. **Kohn-Abrest**: The nitrides and oxides extracted from aluminium heated in air.—L. **Grenet**: The cementation of silicon steels. Silicon steels which do not undergo cementation in wood charcoal can be readily cemented by the use of prussiate of potash.—M. **Vournasos**: The reducing action of alkaline formates on certain mineral compounds. Boron nitride heated with an alkaline formate gives off a mixture of hydrogen, ammonia, and boron hydride. The proportion of the latter compound may amount to 1·5 per cent.—Léo **Vignon**: The phenomena of electric transport in solutions of certain colouring materials. Transportation phenomena are very clearly produced with the colloidal solution of several dyestuffs, proving the presence of undissolved granules carrying appreciable electric charges. With colouring matters in true solution these effects are not produced.—E. **Darmois**: Artificial camphor. It is possible to prepare both the dextro and lævo optically active forms of synthetical camphor.—F. **Couturier**: The condensation of pinacoline with its esters.—Jacques **de Lapparent**: The basic rocks of Saint-Quay-Portrieux (Côtes-du-Nord) and their relations with the pegmatite lodes which traverse them.—Victor **Henri,** André **Helbronner,** and Max **de Recklinghausen**: The sterilisation of large quantities of water by the ultraviolet rays. The arrangement of lamps described is capable of sterilising water on the large scale with an expenditure of 36 watt-hours per cubic metre of water treated.—Ch. **Dhéré** and M. **Gorgolewski**: The preparation of demineralised gelatin and some of its chemicophysical properties. Two methods of purification have been used, dialysis and freezing. The gelatin thus obtained is practically free from ash. It forms jellies, but less well than when electrolytes are present. Between certain limits of concentration solutions of this highly purified gelatin are opalescent, this opalescence disappearing on adding traces of alkali.—H. **Stassano** and A. **Daumas**: The double *rôle* of calcium in the coagulation of blood and lymph.—M. **Weinberg**: The influence of feeding on the production of spontaneous atheroma.—Ph. **Glangeaud**: Archæn formations in the Forez mountains. —Wilfrid **von Seidlitz**: The crushed granites (mylonites) of the Grisons, the Vorarlberg, and the Allgäu.—J. **Thoulet**: Marine sediments of atmospheric origin.

Cape Town.

Royal Society of South Africa, March 16.—Mr. S. S. Hough, F.R.S., president, in the chair.—Dr. R. **Marloth**: Some new South African succulents. Among the new species are some of special biological interest. *Mesembrianthemum mitratum* was discovered in the desert belt east of Port Nolloth by Mr. Garwood Alston. The shrub bears at the end of the apparently dead branches a fleshy knob. This consists of two closely joined leaves, between

which the flower appears. Flower and fruit are then fed by the sap of the knob until fully developed, when nothing is left of the sheltering knob except its skin. Another species of Mesembrianthemum takes the same care of its flower and fruit, nursing them within its own body; but it is even more cautious than its big brother, for it buries itself entirely in the ground and shows only the apex of its few leaves. As the ends of the leaves are flat, flush with the ground, and coloured exactly like the rusty gravel, it is practically impossible to detect them when they are not in flower. *Euphorbia elastica* is the species from which some sort of rubber has been manufactured in Little Namaqualand, and, although the quality was not good, it is not impossible that, with the present boom in rubber, even those barren deserts may see a flourishing industry.—R. A. **Lehfeldt**: Variation of gravity. There have been differences of opinion as to the way in which the value of gravity is affected by height above sea-level, and special interest attaches to measurements on a really larger tableland. The result of observations taken at Johannesburg and Vereeniging is that the variation per metre is 0·000236, considerably less than that given by Helmert.—W. T. **Saxton**: The ovule of the Bruniaceæ. The main point brought out in this paper is that the ovule in the Bruniaceæ is pendulous and anatropous, with a dorsal raphe. There is a simple massive integument with a long slender micropyle.—R. **Brown**: *Chrysochloris namaquensis*, Brown. *Chrysochloris namaquensis* was named from skulls found at Garies in the disgorged pellets of owls. A description is now given of the skin. A remarkable feature of the species is that the third molar is about as frequently absent as present.

DIARY OF SOCIETIES.

THURSDAY, APRIL 21.

ROYAL SOCIETY, at 4.30.—The Incidence of Light upon a Transparent Sphere of Dimensions comparable with the Wave-length: Lord Rayleigh, O.M., F.R.S.—On the Improbability of a Random Distribution of the Stars in Space: Prof. Karl Pearson, F.R.S.—The Total Ionisation produced in Different Gases by the Kathode Rays ejected by X-Rays: Dr. R. D. Kleeman.—Tone Perception in *Gammarus pulex*: Prof. F. J. Cole.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

CONCRETE INSTITUTE, at 8.—The Effect of Sewage and Sewage Gases on Portland Cement Concrete: S. H. Chambers.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Hydro-electric Installations of Sweden: A. V. Clayton.

ROYAL SOCIETY OF ARTS, at 4.30.—The Arts and Crafts of Tibet, and the Eastern Himalayas: J. Claude White.

ROYAL GEOGRAPHICAL SOCIETY, at 4.30.—Dewponds: E. A. Martin.

LINNEAN SOCIETY, at 8.—The Seedling and Adult Anatomy of *Welwitschia mirabilis*: Miss M. G. Sykes.—Anthomyidæ auf den Seychellen gesammelt: Prof. P. Stein.—The Dermaptera of the Seychelles: Dr. Malcolm Burr.—The Pteropoda and Heteropoda collected by the Percy Sladen Trust Expedition in the Indian Ocean: Dr. J. J. Tesch.—Die Pilzmücken Fauna der Seychellen: Dr. G. Enderlein.

OPTICAL SOCIETY, at 8.—Historical Exhibit of Spectacles: E. C. Bull.—Abrasives and Polishing Materials: Dr. W. Rosenhain.

FRIDAY, APRIL 22.

ROYAL INSTITUTION, at 9.—The Telegraphy of Photographs, Wireless and by Wire: T. Thorne Baker.

PHYSICAL SOCIETY, at 5.—Further Tests of Brittle Materials under Combined Stress: W. A. Scoble.—The Magnetic Balance of Curie and Cheneveau: C. Cheneveau with A. C. Jolley.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The History and Present Method of Quay-wall Construction at the Port of Rotterdam: H. C. A. Thieme.

SATURDAY, APRIL 23.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer.

MONDAY, APRIL 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Aldabra and Neighbouring Islands in the South-west Indian Ocean: J. C. F. Fryer.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Brick-making: Dr. A. B. Searle.

INSTITUTE OF ACTUARIES, at 5.—Analysis and Apportionment of the Expenses of Management of a Life Office with a view to ascertaining the Office Premium Loadings: H. J. Rietschel.

TUESDAY, APRIL 26.

ROYAL INSTITUTION, at 3.—The Mechanism of the Human Voice: Prof. F. W. Mott, F.R.S.

FARADAY SOCIETY, at 8.—Is Water an Electrolyte? Prof. P. Walden.—On the Nature of Molecular Association in the Special Case of Water: Prof. Ph. Guye.—Liquid Water a Ternary Mixture. Solution-volumes in Aqueous Solutions: W. R. Bousfield and Dr. T. M. Lowry.—The Specific Heat of Gaseous, Solid, and Fluid Water: Communications from William Sutherland and Prof. W. Nernst.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Mythology and Superstitions of the Lengua Indians of the Paraguayan Chaco: Rev. H. T. Morrey Jones.

INSTITUTION OF CIVIL ENGINEERS, at 8.

WEDNESDAY, APRIL 27.

GEOLOGICAL SOCIETY, at 8.

ROYAL SOCIETY OF ARTS, at 8.—Irish Linen and some Features of its Production: Sir William Crawford.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, APRIL 28.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Rotatory Character of some Terrestrial Magnetic Disturbances at Greenwich and on their Diurnal Distribution: R. B. Sangster.—The Chromophil Tissues and the Adrenal Medulla: Prof. Swale Vincent.—The Liberation of Helium from Minerals by the Action of Heat: D. O. Wood.

ROYAL INSTITUTION, at 3.—Blackfeet Indians in North America: Walter McClintock.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Earthed *versus* Insulated Neutrals in Colliery Installations: W. W. Wood.

MATHEMATICAL SOCIETY, at 5.30.—The Accuracy of Interpolation by Finite Differences: Dr. W. F. Sheppard.—Note on Maclaurin's Test for the Convergence of Series: G. H. Hardy.

FRIDAY, APRIL 29.

ROYAL INSTITUTION, at 9.—Matavanu: a New Volcano in Savaii (German Samoa): Dr. Tempest Anderson.

SATURDAY, APRIL 30.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

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THURSDAY, APRIL 28, 1910.

DYNAMICS IN ENGLAND, FRANCE, AND GERMANY.

(1) *Elementary Mechanics of Solids and Fluids.* By Dr. A. Clement Jones and C. H. Blomfield. Pp. vi+366+xvi. (London: Edward Arnold, n.d.) Price 4s. 6d.

(2) *An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies.* By S. L. Loney. Pp. viii+374. (Cambridge: University Press, 1909–10.)

(3) *Initiation à la Mécanique.* By Ch. Éd. Guillaume. Pp. xiv+214. (Paris: Librairie Hachette and Co., 1909.) Price 2 francs.

(4) *Die Mechanik, eine Einfuhrung mit einem metaphysischen Nachwort.* By Dr. Ludwig Tesar. Pp. xiv+220. (Leipzig and Berlin: B. G. Teubner.) Price 3.20 marks.

(5) *Vorlesungen über technische Mechanik.* By Prof. Dr. August Föppl. III. Festigkeitslehre, 4th edition. Pp. xvi+426. Price 10 marks. VI. Die wichtigsten Lehren der höheren Dynamik. Pp. xii+490. Price 12 marks. (Leipzig: B. G. Teubner, 1909–10.)

NEARLY five years have elapsed since the indefatigable Prof. Perry opened a discussion on the teaching of mechanics at Johannesburg. Mr. Blomfield is a teacher of considerable experience, and this book may be safely assumed to be the outcome of a study of this and other similar reports, combined with a practical knowledge of the difficulties of teaching boys, and of the requirements which a teacher has to satisfy on the part of examining-boards over which, unfortunately, he possesses no power of control. There have been a few, but not many, books on elementary mechanics published since the Johannesburg discussion, and we naturally examine the present book with a somewhat hypercritical eye, in the hope of finding some indications as to whether any real improvement has been effected since then. Let us begin with generalities, and then descend to details.

(1) In the first place, a good deal of discussion has taken place as to how far the use of text-books is desirable in school teaching, the following alternatives being proposed:—

(*a*) No text-book.

(*b*) A text-book consisting of examples only.

(*c*) A text-book containing a complete exposition of the subject.

It is the opinion of many of the best teachers that a text-book should contain a brief but sufficiently complete outline of fundamental principles, but that examples should be the main feature. In this respect Messrs. Jones and Blomfield's book leaves nothing to be desired. It is very largely made up of examples, far more than any boy could work through in a reasonable time, and the teacher who wishes to adapt the course to his own requirements will only have to put a tick against those he means to set to his class.

In the second place, it is undoubtedly desirable, as the authors claim, to teach statics and dynamics simultaneously with hydrostatics, and it is important, not only that the three should for convenience be comprised in one book, but also that the simultaneous treatment should not give rise to serious difficulties in regard to logical sequence in any one of the subjects.

When, however, we examine the result we find that the mixture of the three subjects in each chapter leads to some rather striking anomalies, and the reader naturally asks, What has Atwood's machine got to do with the U-tube and the barometer? Why do Boyle's and Charles's law come in the same chapter with graphical methods? What connection exists between centres of gravity and Archimedes's principle, or between force diagrams and centres of pressure? Would not centres of gravity and centres of pressure go better in the same chapter? If, however, the authors seriously think that this somewhat heterogeneous mixture is found beneficial for teaching purposes on the ground that it keeps a variety of different ideas before the pupils at the same time, no doubt something can be said in its favour, and we should gladly defer to their views.

Passing to matters of detail, we naturally expect to find, in the examples, questions of a rather more practical character than in the older text-books. But the pupil who works through the questions might almost believe that there were only three acute angles in existence—30°, 45°, and 60°. Why is it that other angles so seldom figure in them? Every boy nowadays has his tables of logarithms, and the first thing he should do when he learns the parallelogram law and Lami's theorem is to calculate resultants, using the tables of log sines, &c. What is the use of teaching him statics if he can only apply the methods to three particular angles? But the absence of other angles is the more remarkable when we speculate as to the sources from which the questions have been taken, especially in view of the fact that Government examination papers have been consulted, and that in some of these, 30°, 45°, and 60° have, we believe, been taboo for some years past. Again, in the chapter on projectiles, a good many examples are to be solved by writing down the equations, but we have failed to find any attempt to make the pupil *draw the paths of projectiles by plotting.* Is not this calculated to produce the type of student who uses elaborate algebra to prove an almost self-evident result and generally fails? We have had abundant experience of such students' failures in simple projectile questions, and begin to wonder whether it would not be better to omit the subject altogether.

On the other hand, the book contains a good many things which we had believed were at last dead and buried. What is the use of telling a boy that if a particle is going north-east at 10 feet per second for one second "it has travelled a distance OL ($5\sqrt{2}$ feet) due E., and a distance LP ($5\sqrt{2}$ feet) due N."? If he has any common sense he ought to think that it would be equally sensible to say that two people starting from London and Cardiff at 2 p.m., with

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tickets from London to Cardiff and Cardiff to Glasgow, could get to their destinations simultaneously by the 2 p.m. London to Glasgow. It would be far better to omit all these old-fangled misstatements, including the one that "if a particle has simultaneously three velocities represented by the sides of a triangle it remains at rest," and merely to give the definition of component velocities in § 5, and some discussions on relative velocity.

Atwood's machine seems too fashionable to be omitted nowadays, but it would be better to bring friction up to the front before discussing the motion of a 10 lb. weight on a table, pulled opposite ways by weights of $1\frac{1}{2}$ lb. and 2 lb. hanging over the edge, or a 4 lb. mass on an inclined plane. In the figure of the condensing pump the arrow seems to suggest that air enters the barrel when the piston is moving the opposite way. "Whole pressure," which is meaningless except for plane areas, again crops up on p. 217. When shall we see the last of it? The oar once more figures as a lever of the second class. It is to be wished that every person who placed it there would try pulling a boat out in shallow water with the ends of his oars touching the bottom and a boy on the bank holding the boat back with a string. Under "machines" the so-called "first and third systems of pulleys" crop up with their usual pertinacity. It would be interesting if those who take so much interest in these particular machines and ignore the crab were asked to arrange for lifting building materials to the top of a high scaffolding, and to watch the result when their instructions were carried out.

Our general conclusion is that if boys have to learn what is contained in this book they will be efficiently and well trained on these lines by following Messrs. Jones and Blomfield; but there are a good many things they had far better leave unlearned, and a good many other things they ought to learn instead. It should be mentioned that calculus is not used, and moments of inertia are not included in the scope of the book.

(2) Controversial questions regarding the teaching of mechanics do not enter so prominently in connection with Prof. Loney's book, for by the time its standard has been reached dynamics has practically become a branch of pure mathematics, while, on the other hand, the student has had a good laboratory course in physics or engineering. The book, in fact, pretty exactly fits the requirements of B.Sc. candidates in a modern university college in the third year of their curriculum. It deals with rectilinear motion (including resisting media), central orbits, motion about a fixed axis, uniplanar rigid dynamics, energy and momentum, a little three-dimensional rigid, Lagrange's equations, &c. There is always a difficulty with these students, because this ground assumes a knowledge of pure mathematics that they cannot acquire before their third year. The appendix on differential equations is useful in this connection. A few points will have to be attended to in a future edition. The equation of motion for varying mass (p. 130) does not generally hold when a body is *parting with* matter. D'Alembert's principle requires more explanation than is contained in the statement, "Now the internal forces of the body are in equilibrium among themselves, for by Newton's third law there is to every action an equal and opposite reaction." This explanation the lecturer can, however, give. But a most amazing and doubtless unintentional mistake is made on p. 302, where the equations of motion in three dimensions are given as $Ad^2w_x/dt^2 = L$ instead of Euler's equations. We should like to have seen a few more examples in which the answer leads to a definite conclusion in the form of a numerical result instead of so many algebraic formulæ connecting masses m, lengths $2a$, and angles θ. But such questions are, we admit, rather hard to collect, and the teacher and student should, therefore, be grateful for the flywheel questions on pp. 217–9.

Up till the present no one book has sufficed for students taking this course, and, indeed, there has been great difficulty in advising them as to what to get. Prof. Loney has done useful work in providing students with a suitable work, and when he states that he has verified every question, the task cannot have been an easy or profitable one.

In this revision, the paradoxical rough board on a smooth plane seems to have escaped notice in p. 210, ex. 2, while on p. 217 we have "A uniform rod AB is freely movable on a rough inclined plane whose inclination to the horizon is i and whose coefficient of friction is μ about a smooth pin fixed through the end A." "Coefficient of friction of a rough plane about a smooth pin" reminds us of the newspaper English so often quoted in *Punch*.

The treatment of centrodes is very useful.

(3) M. Guillaume's "Initiation" is stated to be one of a series intended to be used for teaching children. In this connection, the question arises, What is the age of the children contemplated by the author? In the editorial preface by M. C. A. Laisant four to twelve years is suggested. But, even after allowing for the differences between English and French children, the author's treatment of the subject seems too philosophical for such young pupils. As a preliminary preparation to the study of mechanics we have a chapter on "How Nature is Studied," the headings of the paragraphs being "Observation and Experiment," "Approximation and Simplification," "Need of Simplicity," "The Limits of Experiment," "Illusion," "Education of the Senses; Measurement," "Induction and Deduction." Illustrations are taken from the photographs of moving bullets, photometry, and so forth. In the next chapter, which deals with kinematics, we have a discussion of space, velocity, and acceleration graphs. The author in the preface considers that dynamics should be treated before statics. His argument might, however, very well be used the other way. He asks why the majority of bodies on the earth appear to be at rest, and points out that this is due to the existence of resistances such as friction, and remarks *inter alia* that if these forces are unknown at the time when statics is begun

this becomes an artificial science or a simple abstraction. Would it not, however, be equally correct to describe dynamics as an "artificial science or simple abstraction" because it deals only with what *would* happen if certain existing resistances were absent?

The subject-matter extends up to and including couples, circular motion, a little about properties of matter, such as elasticity and ballistics, and a final paragraph dealing with Jules Verne's hypothetical voyage to the moon.

It is not to be denied that "philosophy of science" is much more studied in France than in this country. It also appears that the book is primarily written for those who have to teach children rather than for the children themselves. All we can say is that a course of instruction based on this book would in all probability be far above the heads of English children of the ages contemplated.

(4) While Prof. Tesar has "said his own say" in his preface and metaphysical appendix, his object in the rest of the book has been to present the principles of mechanics in a clear and intelligent form, and to employ practical illustrations as far as possible. In both these aims he appears to have been very successful. He is careful to distinguish between forces (Kräfte) and force effects (Kraftäuszerungen), pointing out that the parallelogram law applies to the latter, and that its truth for any physical vector quantities is based on experience. His readers should learn to discriminate clearly between the formal rational dynamics and its applications to the practical study of mechanics. For want of this distinction the whole subject in less careful hands often becomes more appropriately describable as dogmatics. The practical illustrations are very instructive and suggestive. How many who have taught rigid dynamics have thought of working out the condition whether a bell will or will not ring when it is swung? The author gives practical calculations for a bell in Cologne Cathedral cast from the cannon captured in the Franco-Prussian War, which failed to ring until its clapper was altered in length.

(5) As has been previously pointed out in reviews, Prof. Föppl's treatises on technical mechanics are of a far more advanced character than the mechanics taught commonly to technical students in this country. Vol. iii., which includes a large portion of the mathematical theory of elasticity, now reaches us in its fourth edition. The new volume, "The Most Important Studies of Higher Dynamics," deals with relative motion, systems with several degrees of freedom, in particular compound pendulums, including the bell and its clapper, the gyrostat, and an outline of hydrodynamics. Under the gyrostat we have a detailed discussion of Schlick's ship governor, and in a circular issued with the book we are asked to point out that the Brennan mono-rail came too late to be included in the book, a short note at the end being all that was possible, as the whole of the text was already in print. It is, however, pointed out that the theory of the Schlick gyroscope is applicable with slight modifications to the mono-rail, some terms occurring in the equations having merely to be reversed in sign. Thus an interesting exercise is provided for those possessing the necessary mathematical knowledge, to go over the work introducing the necessary changes, and doubtless the next edition will see them in the text.

G. H. BRYAN.

HARDY TREES AND SHRUBS.

Trees and Shrubs of the British Isles, Native and Acclimatised. By C. S. Cooper and W. P. Westell. Vol. i., pp. xxxii + lxxxiv + 108; vol. ii., pp. viii + 261; 78 full-page plates by C. F. Newall. (London: J. M. Dent and Co., 1909.) Price, two vols., 21*s*. net.

AMID the torrent of books on gardening with which a patient public has been deluged during recent years, we have searched in vain for a really comprehensive and authoritative work on hardy trees and shrubs. Of mere book-making there has, of course, been no end. It is so easy to sit at a desk and boil down from Loudon, Sargent, &c., and from the copious literature in horticultural journals, sufficient to make a respectable-looking volume, without ever taking the trouble to turn over a leaf or dissect a flower on one's own account. But this method has its disadvantages. The same stale old errors are once again repeated, and to them our new author must, perforce, add some of his own. There has been too much of this kind of tree literature in the past, and it was with a feeling of pleasant anticipation that we turned to these two handsome volumes in the hope that a work had at last been written worthy of the subject.

That it marks a considerable advance on much that has appeared is certain, but its scope is somewhat limited, and the authors do not appear to us to have done the best that could have been done within the limits they set themselves. British trees and shrubs are done thoroughly and well, and those portions dealing with them constitute the most valuable part of these volumes. When the authors deal with what they term "acclimatised," as distinct from native, species, their work often suggests the study and the bookshelf, rather than the open air and the living tree. For it is by no means free from error, and at times shows a lack of intimate knowledge of the plants dealt with.

The book opens with an introduction in which the general subject is discussed pleasantly and suggestively. It is an attempt to interest the hitherto uninterested reader, not only in the more evident beauties of leaf and flower, but to get him also to appreciate those profounder beauties of trunk and branch and bud which we are afraid the average reader often does not discern, but which make the leafless woods in their season as full of delight to the real tree-lover as the full leafage of June. This part of the work was well worth doing and is well done.

Some fifty or sixty pages are then devoted to the discussion of injurious and useful insects, galls, and fungoid pests, with directions for the composition and application of various remedies. This, although useful, is too liberal an allowance for such subjects in a

work running to less than 500 pages. Many insects are described and discussed individually which are not particularly troublesome, and might, at any rate, have been treated collectively. We see no mention of the beech-bark coccus, a pest which is causing grave concern both here and on the Continent among owners of beech woods. The remainder of the work is occupied by a detailed description of some 550 species of "native and acclimatised" trees and shrubs. A description of the characteristics of each natural order prefaces the description of the species belonging to it. This space, we think, might have been better occupied with a discussion of the genus. A description of the great order of Ranunculaceæ, for instance, has only a very general bearing on Clematis, and it was scarcely worth while to preface the description of the solitary rubiaceous species here dealt with by an account of the great order to which it belongs.

The old problem of the "popular" name has been met by a brave effort on the part of the authors to provide nearly all the plants they mention with one. If a species had not one before they appear to have invented one. But the result is not always happy. We hardly know whether such a name as "Narrow-leaved Jasmine Box" for *Phillyrea angustifolia* (p. 107) indicates too dull or too vivid an imagination, for this shrub has no relationship with the box, nor does it bear any resemblance to the jasmine either in leaf or flower. The very next species, *P. decora*, is called "Vilmorin's Mock Privet," which is neither pretty nor correct.

The descriptions are carefully done, although somewhat too technical for the amateur, as for example where the flowers of common oak are described as "monœcious, anemophilous, proterogynous," and where the fruit of magnolia is termed an "etærio of follicles." Still, accuracy is the chief thing, and we do not notice many serious lapses. One of the worst is the description of *Ceanothus rigidus* as a deciduous climber with alternate leaves (p. 48). It is a perfectly evergreen bush with opposite leaves. Then *Acer circinatum* is said to have "greenish-white" flowers. Anyone who has had a personal acquaintance with this tree could not fail to have noticed its drooping corymbs of reddish-purple flowers, which make it perhaps the most attractive of commonly cultivated maples in regard to blossom.

The number of cultivated species of hardy trees and shrubs now exceeds 3000, and it would be an impossible task to select one-sixth of these for treatment and satisfy everyone. Yet the selections here made betray an indifferent acquaintance with some groups. *Berberis empetrifolia*, a rare shrub seldom seen in good condition, is included, but of *B. stenophylla*, in some respects the finest of all flowering evergreens, not a word is said; and whilst a weedy shrub like *Stephanandra Tanakae* is described, a fine handsome bush like *Exochorda grandiflora*, its near relative, is ignored. But the worst instance of this defect in these volumes is the inclusion of the American plane (*Platanus occidentalis*). The authors say this is to be found in "parks, gardens, avenues," and that it is "usually larger and more rapid in growth than the Eastern plane" (p. 144, vol. ii.). We had thought it well known to all tree-experts by now that the American plane is absolutely worthless in this country. So far from being comparable with the Eastern plane, there is not, we believe, a single tree in these islands with a trunk 6 inches in diameter. All the trees so called are forms of *P. acerifolia*, the common plane of London. Thus is an old error dating from Phillip Miller's time, and continued by Loudon, again perpetuated. The cultural notes will be found useful, although an absence of personal experience is again at times evident, as when it is stated that *Cistus ladaniferus*, from the sun-baked hills of Spain and Portugal, is suitable for shady places (p. xxxi).

Whilst we have felt bound to point out the obvious defects of this work, it must not be supposed we are blind to its merits. These are many, and to the great bulk of the matter no exception can be taken. For the drawings of Mr. Newall we have nothing but praise; they are botanically accurate as well as artistic. The coloured plates are of unequal merit; the picture of *Magnolia conspicua*, for instance, is either wrongly named or badly coloured, but this we suspect is more the colour printer's fault than the artist's. The printing, typography, and paper are all admirable.

ANTEDILUVIAN CHRONOLOGY.

The Dates of Genesis. A Comparison of the Biblical Chronology with that of other Ancient Nations. With an Appendix on Chronological Astronomy. By Rev. F. A. Jones Pp. 333. (London: Kingsgate Press, 1909.) Price 5s. net.

THIS is one of those strange little works which are continually issuing from the clerical workshop with the aim of expounding the early chronology of the Bible. Mr. Jones has many glimpses of real knowledge of archæological science, and has evidently read widely on the subject, but not always wisely, and he perpetrates several blunders. The most patent impossibility in the book is the absurd date assigned to the building of the Great Pyramid, viz., 2170 B.C., on the authority of Sir John Herschel. This is utterly impossible, on historical grounds.

We do not know what to make of Mr. Jones's views of modern scientific knowledge of the beginnings of human civilisation. He seems to think that human beings were originally placed in the world in a highly civilised condition, and ingeniously explains away the damning fact of the gradual evolution of man's tools and culture from the Older to the Newer Stone age and then to the age of Metal. He says that the ancient flint implements may indicate not "an early period in the development of art," but

"express limitation of opportunity. Wanderers from a civilised centre would, unless possessed of considerable personal ability, soon degenerate into using the simple methods that are characteristic of savage tribes . . . the existence of these flint weapons, in outlying districts, may not be pressed so far as to prove a date as being long before more advanced civilisation in the great centres of population."

That is to say, Palæolithic implements are the tools of degenerate offshoots from the highly civilised pre-

diluvian "patriarchals." For between the Palæolithic degenerates and the Neolithic degenerates came the Flood, which killed off all the extinct animals, such as the mammoth, which

"at all events, is not such an extremely ancient animal. Its remains are even to-day excavated, in some cases, as in Polar regions, with its flesh and hair intact."

It is difficult to know what to make of a writer who, in the twentieth century, believes, apparently, in the actual historical existence of Noah and his ark, and, by "combining the traditions of Jews, Arabians, and other nations with the story as told in the Hindu Puranas and the Sybylline [*sic!*] Oracles," arrives at the following interesting account, "which may or may not be true," of what happened about the time of the Flood (pp. 164, 165):—

"Mahaleel was a very distinguished man who married a widow in the line of Cain. His son, Jared, thus acquired a claim to the rulership of the world, and exercised it for some time with great distinction. He is said by some to be the great Sesostris of the Greeks. . . . Methuselah maintained the holy traditions, and for his sake the flood was postponed till his death had taken place. Noah was by distinction the righteous man. . . . The nation descended from Ham very quickly turned aside to the old idolatry, and worshipped their ancestors under various names. These may be traced in Egypt, Chaldea, Phœnicia, and elsewhere. The children of Shem became kings of Magadha, but the dynasty ended about 2100 B.C. Noah was soon deposed from his rule by his sons, and driven away from the territory occupied by them. According to one account he was last seen about 2000 B.C., and he was of a colour between white and ruddy, and bald-headed." (!)

FIELD ORNITHOLOGY.

Camps and Cruises of an Ornithologist. By F. M. Chapman. Pp. xvi+432. (London: Hodder and Stoughton, n.d.) Price 12s. net.

FOR seven years the author, with the assistance of artist and *preparateur*, devoted the nesting season of birds to collecting specimens and making field studies and photographs on which to base a series of what have been termed "Habitat Groups" of North American birds for the American Museum of Natural History. These groups are designed to illustrate not only the habits and haunts of the birds shown, but also the country in which they live. The birds, and, in most instances, their nests and young, are therefore placed in a facsimile reproduction, containing from 60 to 160 feet of the locality in which they are found, and to this realistic representation of their habitat is added a background, painted from nature, and so deftly joined to the foreground that it is difficult to distinguish where one ends and the other begins. A reference to the photographs of these groups, which form some of the illustrations of this delightful book of field ornithology, will convince anyone at once of the truth of this remark. Some of these panoramic backgrounds portray not only the haunts of certain American birds, but America as well.

In the pursuit of his calling the author has had the good fortune to behold some of the most interesting and remarkable sights in the world of birds. The object of the present volume is to perpetuate his experiences and studies by telling the story of the various expeditions of which the groups were the objects, adding such information concerning the birds observed as seems worthy of record, and illustrating the whole with many photographs from nature, and a number of the groups themselves. The result is one of the most readable as well as informing books of the kind we have had the pleasure of seeing.

With the exception of one chapter, the whole book deals with American birds. But this need not be a drawback in the mind of even those whose ornithological interests are almost wholly confined to British birds. The author remarks that next to their native birds there are probably none of more general interest to the average American nature-lover than the birds of England. This is partly due to sentimental reasons. But we can return the compliment, for others. One is that many American birds, although considered by systematists as distinct species, are so like European birds that for all practical purposes of the field ornithologist they may be considered the same, while others are absolutely identical. So that in reading a book about the habits of these birds in America we are learning something more about our own birds' habits, modified a little, perhaps, by a slightly different environment or by different conditions of life. This last comes home to us when we read the account of Gardiner's Island ("within one hundred miles of our most populous city"), where there are no rats and no cats, "the ogres of the bird-world," and hardly any "vermin" destructive to bird-life. This large island, containing 4000 acres, is a place of peace and plenty for the birds. The whole account of it is full of interest, but the most remarkable fact is that the osprey, which is *very abundant,* builds its nest often in lowly situations, and actually in some cases on the ground. A number of illustrations of the ospreys and their nests are given, the great piled-up heaps of sticks built by the birds which breed on the beach affording excellent chances of photographing the old birds at the nest.

Some birds are more get-at-able in the North-West than they are, say, in that almost unknown land, the marshes of south-eastern Europe. Take the great white pelican, for instance. It is a most difficut—nearly impossible—bird to study in Europe; but in many of the numberless lakes of Manitoba, Saskatchewan, and Alberta, invariably upon islands, white pelicans nest, a colony containing anything from a dozen to several thousand birds. This bird so closely resembles the European one that it used to be considered identical with it. The chapter on and illus'rations of it are therefore very welcome, for the author saw a good deal of pelicans.

Perhaps the most interesting chapter in the book describes the flamingo—not, indeed, our pink flamingo, but the brilliant red species (*Ph. ruber*). However, a flamingo, so far as life-habits are concerned, seems to be simply a flamingo wherever he lives. It is here truly remarked that there are larger

birds than the flamingo, and birds with more brilliant plumage, but no other large bird is so brightly coloured, and no other brightly-coloured bird is so large. When to these more superficial attractions is added the fact that little or nothing has hitherto been known of the nesting habits of this singular bird, one may, in a measure at least, realise the intense longing of the naturalist, not only to behold a flamingo city, but at the same time to lift the veil through which the flamingo's home life has been but dimly seen. Nearly forty pages are devoted to the lifting of this veil for the reader, and the account is illustrated by more than a score of pictures of the birds at and on their nests, and of the nests, eggs and the young in various stages; included among these are two beautiful coloured photographs of the adult birds, in one of which they are seen feeding their young in the nest.

It is quite impossible to find space even to enumerate all the contents of this charming book, but Florida, Bahama, the western prairies, California, and many other localities were visited by the author, and are here described. Lastly, we have a chapter on his impressions of English bird-life; and the impressions of such an experienced bird-man are distinctly valuable and informing, and will be read with the greatest interest by our field ornithologists. We cannot enter into them widely here. As he approached the coast of Wales the "boreal" birds he saw about the stacks and islands of Wales afforded convincing evidence of high latitude, and, at the same time, an admirable illustration of the faunally composite character of English bird-life, types Americans are accustomed to consider representative of northern and southern life-zones finding in England congenial surroundings. Unlike some visitors, the author was not too late to hear the nightingale; he was disappointed at first with the song of the skylark, but before leaving England found himself listening to it with increasing pleasure. None of the birds seen from the train impressed him more than the peewit. We read:

"The bird's size, form, and colours, its grace of carriage on the ground, and dashing, erratic, aërial evolutions, give it high rank as an attractive part of any avifauna; while its abundance, in spite of the demand which places thousands of its eggs on the market annually, is inexplicable."

This is all true, though most of the eggs come from the Continent; but a bird which can furnish Mr. Chapman with "a brand new sensation in bird-life" must be something we ought to be proud of.

The author visited various parts of England, and many of our famous sea-bird haunts. His pictures of these places (including one of Selborne) are delightful, and everything he has written about our avifauna is well worth reading. It is satisfactory to read that birds are more abundant here than they are in North America. The book is very full of illustrations, and they are excellent—far better than most of the photographs of this kind. But the heavily leaded paper on which it is printed makes it simply too heavy to hold without actual weariness!

O. V. A.

EXOTERIC PHILOSOPHY.

(1) *In the Abstract.* By N. Alliston. Pp. 156. (London: Swan Sonnenschein and Co. Ltd., 1909.) Price 2*s.* 6*d.*

(2) *Progressive Creation: a Reconciliation of Religion with Science.* By Rev. H. E. Sampson. In two vols. Vol. i., pp. xii+484; vol. ii., pp. vi+517. (London: Rebman, Ltd., 1909.) Price 21*s.* net.

(3) *Progressive Redemption.* By Rev. H. E. Sampson. Pp. xxiv+616. (London: Rebman, Ltd., 1909.) Price 12*s.* 6*d.* net.

(4) *Scientific Idealism, or Matter and Force and Their Relation to Life and Consciousness.* By W. Kingsland. Pp. xxiii+427. (London: Rebman, Ltd., 1909.) Price 7*s.* 6*d.* net.

THESE books have this much in common, that none of them bears the academic hall-mark. Of the three writers, Mr. Alliston is the most ambitious of a precise logic. His book consists of a group of essays on such various topics as "The Planetary Distances," "Materialism," "The Value of Things." His criticism of the first law of motion is perhaps the most original effort in the book. He is dissatisfied with a formulation which assumes that rest and frictionless motion are alike constant; he holds that frictionless motion would cease as soon as the original force should be exhausted. Mr. Alliston admits that the law as stated must be considered practically adequate; he does not attempt to make any inference, dynamical or metaphysical, from his criticism; and the essential proof for this inconclusive result, the explanation of how an ideal unhindered velocity would be diminished, he has not provided. Mr. Alliston's essay on materialism is a clear and simple re-statement of now commonplace criticism; he does not, however, sufficiently realise the difficulty of finding a moral differentiation between materialism and a spiritualism which does not promise the conservation of individuality. The book is pleasantly written, and might be turned over with interest and profit by beginners in philosophy.

The authors of the other works placed at the head of this notice have each made a bold attempt to reach the final synthesis which is supposed to be the goal of philosophy. Mr. Sampson's interest is, in the main, theological; Mr. Kingsland's effort is more purely philosophical. The system of the former, though presented with much ability, will, it is to be feared, strike most people as fantastic. He starts from the failure of science to account for evolutionary breaks and "missing links." This failure suggests to him that the facts covered by the current theory of evolution represent an interruption rather than an integral part of the great order of true evolution. That true order is, it appears, a progressive creation of beings who pass by successive reincarnations from lower to higher types, culminating at last in perfect Godhood. A condition of its continuity is the preservation of purity of type, a condition violated by our "Adamic" ancestors, who inter-married with an inferior kind. Sin then entered the world, catastrophic physical changes occurred, and our history since has been a struggle towards the ancient

segregation, a "devolution." The incarnation of Christ was the essential effort of the whole Cosmos to redeem the earth. Mr. Sampson provides a cosmogony for the great spiritual order. The planetary circles and the zodiacal angles in their various relations define the home of the spirit in its various stages of development from the "atom" of original divine ætheric essence to the perfection of Deity. Into the elaboration of this scheme the author has worked much ingenious allegorisation of biblical story, and much mysterious symbolism from Astrologer and Rosicrucian. It is a not uninteresting and hence not unsuccessful attempt in mythology; at least it must appear so to all who do not possess, as Mr. Sampson seems to, the clue to the esoteric illumination of church and brotherhood.

Mr. Kingsland writes with much earnestness to show that truth, beauty, and goodness are only to be realised by man in his union with the Absolute, the one primordial substance, who is at once subject and object, whose nature can be expressed only in paradox, the eternal source and sustainer of all finite existence. We approach Him by ascent from plane to plane of existence—for He is essentially differentiated into planes variously approximating to His own self-sufficiency. For Mr. Kingsland individuality is an involution, and its extreme limit is physical determination; from that man is now evolving towards a realisation of the spiritual ego, which is the "universe" of many human personalities or incarnations. It again is but a phenomenal appearance of the spiritual form of humanity, the one "Divine Son," which is itself a phenomenon of the Absolute. Thus, though Mr. Kingsland professes a belief in immortality, it is necessarily an immortality in which individual experience is not preserved as individual. The temporal individuality must be merely a means for a higher life which transcends it; and, though the author may assert that we are at the same time ends, for the One is within us, this paradoxical conjunction has never satisfied man's moral demands for an end which is both personal and metaphysically genuine. The book is well written, and the exposition of recent scientific theory is admirable, but in the more metaphysical portions repetition is a great blemish.

OUR BOOK SHELF.

A Manual of Botany for Indian Forest Students. By R. S. Hole. Pp. xi+250+xxi+xx plates. (Calcutta: Government Printing Office, 1909.)

THIS work has been prepared primarily for the use of the pupils of the Imperial Forest School, Dehra Dun, in which establishment the author holds the post of forest botanist. The manual ought to prove a good text-book. It is quite up to date and is written in clear, concise language. Should a new edition be called for, and when one considers the object the work is intended to serve this will almost certainly be the case, the author will be well advised to treat systematic botany more fully than he has done in the edition before us. A compact synopsis of the natural families of plants to be met with in British India would be of great value as an aid to the student who will, when he has left the forest school, have occasion to make use of the "Flora of British India," or of one or other of the regional Indian floras based on that fundamental work. The author might also consider the advisability of adding a glossary to the work. Such an addition, besides being of considerable utility in itself, would have the further advantage of enabling him to relieve the morphological part of the work of a certain amount of purely terminological matter and at the same time of allowing terminology itself to be treated somewhat more completely.

Another point to which the author's attention may be directed is the somewhat meagre character of the illustrations. It is, of course, true that, especially at the outset, there is some difficulty in providing for the full illustration of a work published by Government and prepared for the special purpose which underlies the one under notice. So long as it is understood that the work is merely intended to assist the student generally while he is at the forest school, the want of illustrations in company with the text is not likely to be greatly felt. But the work ought to have, and no doubt will have, a further use. Most students will carry the work away with them when they leave the school, and will find frequent occasion in after life to refer to it and refresh their memories. It is then that the need for good illustrations, which help to restore faded ideas and their associations, will be most acutely felt.

In directing attention to these points we would, however, desire it to be understood that no reflection is intended either on the author or on his work as it stands; what appeals to us in making them is rather a purpose that the work, modified as suggested, is calculated to fulfil than the purpose which, as the author explains, it is intended to serve. That it should serve this latter and narrower purpose well we do not doubt, and Mr. Hole is to be congratulated on the presentation of a useful and serviceable manual.

The Light of Egypt, from recently discovered Predynastic and Early Christian Records. By R. de Rustafjaell. Pp. x+169. (London: Kegan Paul and Co., Ltd., 1909.) Price 10s. 6d. net.

MR. DE RUSTAFJAELL's book is a curious mixture, as its title shows. It consists chiefly of a description of various Egyptian objects, some apparently owned by the author (though this is not made quite clear), others bought by him and sold later to the British Museum. These objects are illustrated by fine photographs. They are strung together by means of a general talk compiled by the author from various authorities, which is intended to give an idea of the "light" shed by Egypt upon early civilisation. So far, so good, and the work is not badly done; but the author also launches out into one or two theories of his own, which are hazardous. We may instance his supposed discovery of limestone "vessels" of "Palæolithic" age found with (undoubted) Palæolithic flints on the Theban plateaux. These objects are not artefacts at all, but merely either the hard matrices of flint nodules or else weathered siliceous masses. They are common enough on any Egyptian *gebel* of rough stones. Mr. de Rustafjaell has discovered nothing here. The translation by Mr. Crum of the Coptic manuscript sold by Mr. de Rustafjaell to the British Museum, and included by him in his book, is interesting. The Nubian manuscript also originally obtained by Mr. de Rustafjaell, to whom Mr. Griffiths sends a summary description of it, has already been published in facsimile by Dr. Budge for the Trustees of the British Museum. It is of great importance linguistically.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Precursors of Magnetic Storms.

IN kindly noticing (NATURE, December 30, 1909, p. 259) my short account of the magnetic storm of September 25, attention was directed to the fact that what I called the precursor was experienced all over the world.

As I have little or no opportunities to compare our curves with others, may I be allowed to ask for information through the columns of NATURE?

I call a "sudden start" of the magnet a movement which occurs after several hours of perfect calm, and causes the trace to make a "sharp angle," that is, so sharp that I can unhesitatingly tell the time of the occurrence to the nearest two minutes. Many disturbances, large or moderate, have a "sudden start"—at least here.

My impression has long been that disturbances with a "sudden start" very generally have a kind of "preliminary tremor" some hours before the start; the curve, which we suppose to be quite smooth, is interrupted by a short movement, which lasts but a few minutes, after which the curve resumes its smoothness for the remaining hours. The tremor may be very small indeed, but the two characteristics, to be found on a smooth curve, and to be of very short duration, make it quite easy to point it out and tell the time.

The start of the "preliminary tremor" is in the same direction as that of the disturbance itself, at least as a rule.

I do not venture to hold an opinion as to the connection, fortuitous or otherwise, between the two phenomena, but I should be very glad to know whether the "precursor" is also observed in other countries. The following is the list of all the "sudden starts" of H during the last fourteen months of Zi-ka-wei (January, 1907, to February, 1908, inclusive), with the time of the start and that of the preliminary. A comparison with the curves of some other observatory is invited. Probably the traces will not be found so smooth as here, and some of my "sudden starts" will correspond to progressive starts, but on the whole I hope that a comparison will be possible.

I use Greenwich time.

	Sudden starts	h. m.	Preliminary	h. m.	Remarks
1.	Jan. 8	16 45	Jan. 8	1 45	
2.	,, 11	8 45	,, 10	3 10	H not quite smooth. D very smooth.
3.	,, 14	19 35	,, 14	10 30	
4.	Feb. 7	8 10	Feb. 6	23 55	
5.	,, 9	14 12			Curves not quite smooth.
6.	,, 14	4 37	,, 13	19 47	
7.	Mar. 10	5 3	Mar. 9	16 (?)	Curve not quite smooth.
8.	,, 11	17 23	,, 11	13 45	
9.	,, 21	13 33	,, 21	9 50	
10.	May 18	13 58	May 18	10 52	
11.	June 3	22 55			Curves not smooth.
12.	,, 18	3 42	June 17	17 20	
13.	July 10	14 23	July 10	11 0½	
14.	,, 25	4 18	,, 24	14 40	There is another preliminary at 3½.
15.	,, 28	0 12			Curves not smooth.
16.	Aug. 14	15 3	Aug. 14	11 0	
17.	,, 20	2 24	,, 19	13 30	
18.	,, 30	7 15	,, 30	5 8	And also 29 at 11h. 12m.
19.	Sept. 10	1 50	Sept. 9	15 0¼	
20.	Oct. 13	7 45	Oct. 13	0 0½	
21.	Nov. 21	10 45			The curve of H was lost, until 10h. But D does not show anything.
22.	Dec. 4	5 45	Dec. 3	20 57	
	1908				
23.	Jan. 27	13 48	Jan. 27	0 25	
24.	Feb. 22	12 8	Feb. 21	19 20	

If we put aside No. 21, we have twenty-three occurrences. In eighteen of these there is no doubt; in the three cases in which no precursor was found, and in the two more or less doubtful cases, the curves were not smooth, that is, the "start" was not quite sudden.

In Zi-ka-wei, during the fourteen months considered, the eighteen disturbances which began with quite a sudden start all had one or two preliminaries. The interval between the forerunner and the disturbance ranges from two to seventeen hours of perfectly smooth trace.

Zi-ka-wei, China, March 11.

J. DE MOIDREY.

Centre of Gravity of Annual Rainfall.

THE mere *a priori* criticism which Mr. Watt, in his letter to NATURE of April 14, has bestowed on my letter to NATURE of March 31, dealing with a large class of *concrete physical facts*, is, to my mind, far from satisfactory or sufficient. In the last sentence of my letter I anticipated that it might meet with some such "simple" algebraic criticism.

I did not, as is implied, assert that the use of the C.G. of the year's rainfall would dispense with the ordinary graphic representation of the monthly distribution, but that it appeared to be a convenient method for *comparing* the rainfall distribution at a number of stations in the same country for the same year, as well as at a single station, or for the mean rainfall of the same country, for a succession of years. Obviously, therefore, Mr. Watt's simple types of rainfall for his imaginary stations A, B, C, which belong to very different regions on the earth's surface, have no application, even in theory, to my "suggestions."

As for the practical character of my proposals, the following may be given. They are quite as useful as the comparison of the variation of rainfall with that of population for a decennium in India, which was the subject of a paper given some years ago in the Journal of the Royal Meteorological Society, London. A comparison of the variations in the C.G. of the mean monthly rainfall for the past 50 or 100 years with the agricultural results of those years in the British Isles, &c., for which the data may be available; an examination of these variations in connection with the much-discussed question of weather cycles, so commonly based on rainfall statistics; the detection of serious clerical slips in the tabulation of rainfall; the interpolation of the probable rainfall figures for a month in the event of a rain-gauge or measure-glass being temporarily unserviceable; the detection of the ignorant or inadvertent use of a wrong measure-glass—a matter of frequent occurrence in India, and possibly not unknown in this country.

Rain falls with such seeming irregularity of quantity and date, even in India—and much more so in this "unspeakable" Scotland—that it would appear *prima facie* impossible that there could be any approach to constancy of the date around which the whole year's rainfall balances. If we look at the tables of monthly rainfall for a large number of stations (in the same country) and see that the figures are not even approximately the same for the months or for the whole year, if we consider the difficulties connected with the measurement of rainfall, which are discussed in many of the volumes of "British Rainfall," it is surely surprising that, in spite of all these things, the reported year's rainfall should balance round a date which does not differ by more than a few days for a great many, if not all, the stations in any one year, and that for another year the displacement of this central date is so nearly the same for all of them. By merely looking at the monthly figures or at the graphs of those figures, we cannot accurately estimate either the central date or the amount of its displacement.

The causes which determine the times and amounts of rainfall for any place or country are known only in a very general way indeed. They are so elusive that investigators in their despair have even had recourse to sun-spots or comets' tails as a possible cause of special excess or deficiency of rainfall. They are so elusive that even in India, with its comparatively regular rainfall-seasons and with its special equipment of experts, the problem of

correctly forecasting the monsoon rains either as to time or intensity is still far from complete solution. They are so elusive that the forecasting of rainfall even for three days in this part of the world is not yet conspicuous for its infallibility.

The importance of the laws of rainfall is so incalculably great that it is not extravagant to say that their discovery is the ultimate object of, and excuse for, the millions of meteorological figures that are published annually in all civilised nations. Hence the discussion of rainfall in all its aspects is worthy of encouragement, and in this connection the centre of gravity of annual rainfall may possibly, after all, be of some value. J. COOK.

Edinburgh, April 18.

I AM glad to read Mr. Cook's reply to my remarks, but believe that my criticism cannot be dismissed as a mere *a priori* one, and that it goes to the root of the matter. It is true that Mr. Cook illustrated his proposal in a most exhaustive manner, and that he did not suggest that his method might be of service in comparing the rainfalls of places in quite different climatic regions. But the general reasoning in the first paragraph of my former letter cannot be both correct and incorrect. Assuming it to be correct, it follows directly that even if we confine our attention to the records for a single station we might have the same C.G. for two years which differed greatly from one another as regards the monthly distribution of rainfall. In such a case, what possible significance could attach to the position of the C.G.?

I am heartily in sympathy with Mr. Cook's feeling that the discussion of rainfall in all its aspects is worthy of attention, but note that he himself does not maintain that his method is, but only that it may possibly be, of some value. It is certainly at first sight surprising that the calculated C.G. of rainfall for a large number of places for a given year in, say, Scotland should be very nearly the same, for the monthly rainfalls as ordinarily tabulated exhibit a bewildering complexity; but if the monthly values for the various stations are expressed as percentages of the year's total, the resulting picture is usually of a very simple and symmetrical character, which would lead one to anticipate that the C.G.s for the various stations would approximate closely.

ANDREW WATT.

Scottish Meteorological Society, 122 George Street, Edinburgh, April 22.

The Fertilising Influence of Sunlight.

THE beneficial effect of heat on soil is recorded by Virgil in the following passage, to which Mr. F. B. Smith has directed my attention :—

> "Often too, 'tis good
> To burn the stubbles and with crackling flames
> Consume the empty stalks; whether from thence
> The earth derives a hidden store of strength
> And fattening food, or whether 'tis that fire
> Rakes out the subtlest vice and sweats away
> Excessive damp, or whether by the heat
> New pores are opened and the choked are cleared," &c.
> ("Georgics," Bk. i., lines 100 *et seq.*).

It is interesting to learn from Mr. Fletcher (April 7) that the natives of Bombay, in certain circumstances, subject their soils to heat. Mr. Fletcher regards the explanation given by Dr. Hutchinson and myself as incorrect, and suggests that the effect is due to the destruction of some toxin. This was the first hypothesis we examined, but was found to be insufficient.

(1) Toluened soil (*i.e.* soil treated with a small quantity of toluene, which is subsequently allowed to evaporate *in situ* without washing anything from the soil) is more fertile and more favourable to bacterial activity than the original untreated soil.

(2) When an aqueous extract of untreated soil is added to the toluened soil, there is a still further increase in fertility and in bacterial activity. The same result follows when a minute amount of the untreated soil itself is added instead of the aqueous extract.

(3) When a larger quantity (5 per cent.) of the untreated soil is added a similar effect is produced for a time, then the bacterial activity begins to be depressed. This action increases, and finally the depression, both in bacterial activity and in fertility, is out of all proportion to the 5 per cent. of soil originally added.

Experiment (2) is conclusive against the hypothesis that a soluble toxin exists in the untreated soil which can be put out of action by toluene. For such a toxin should cause a decrease, and not an increase, in productiveness. Experiment (3) is equally conclusive against a relatively insoluble toxin; had this been present the depression should have shown itself at once, and should have been proportional to the amount of toxin, *i.e.* of untreated soil, added.

The *growth* of the injurious factor in experiment (3) seems to necessitate a biological hypothesis. Considering these and our other experiments in detail, Dr. Hutchinson and I see no way out of the conclusion that organisms are present in soil inhibiting the development of bacteria, and therefore of plant food. The organisms, whatever they are, must be larger than bacteria, or they would occur in the extract of experiment (2) along with the numerous bacteria there present—indeed, the beneficial effect of this extract was traced to the unweakened races of bacteria present, partial sterilisation having somewhat weakened the soil bacteria. Further, they develop more slowly than bacteria. As similar phenomena have been observed in all the soils examined, we are justified in supposing that the organisms are widely distributed, and constitute an important factor in soil fertility.

Mr. Fletcher's water-culture experiment is not germane to the point. A toxic body that occurred there would not necessarily come direct from the plant or be found in the soil. It is extraordinarily difficult to keep prolonged water cultures sterile, and until some attention is paid to the bacterial changes going on it is impossible to regard the results as proof of the presence of toxins in soils. Indeed, I know of no satisfactory evidence of their existence in normal soils. E. J. RUSSELL.

Rothamsted Experiment Station, Harpenden.

Pneumatolysis.

IT is thirty-nine years this month since NATURE, over diffident initials, published my first scientific communication that ever saw print. For more than thirty of those years I have been much interested in the physics of plutonic rocks. Quite recently an event has occurred which must be almost without precedent in science. The petrologists have apparently repudiated, with unanimity, what is an axiom beyond dispute with chemists.

For some years past the petrology of plutonic rocks has been based on the new doctrine of "pneumatolysis," or the solvent powers of gases over solids.

Perhaps the last published important work on chemistry is the English version of Ostwald's "Fundamental Principles of Chemistry," 1909. Referring in that work to a certain diagram, representing the behaviour of one solid and one gas, the author writes :—

"From this point the liquid phase exists in the presence of the gaseous phase to the end of the diagram, *because solid substances do not form solutions with gases*" (pp. 186–7). Italics mine.

I believe that every chemist will assent to the above statement. If a gas is to mix with a solid, as a solution, the solid must first be vapourised; but if this be so the greater part of twentieth-century petrology breaks down, because it is everywhere relying on the truth of pneumatolysis.

From the student's point of view the situation is as paralysing as it is stupefying, and there seems nothing to be done but to put away the microscope. It is no work for students to discuss first principles.

Southwood, Torquay, April 18. ARTHUR R. HUNT.

Anomalous Reading of Hygrometer.

MAY not the observation referred to in NATURE of April 7 (p. 165) be a very simple case of latent heat evolution by condensation when the atmosphere is supersaturated with vapour? I think I have seen the wet bulb registering a temperature higher than the dry bulb; but this explanation seemed at the time so obvious that I made no careful verification of the apparent phenomenon.

HUGH RICHARDSON.

Bootham School, York, April 11.

AMERICAN DESERT VEGETATION.[1]

THE popular impression of a desert as an endless plain of tawny sand, rainless, and utterly devoid of vegetation, or perhaps showing a distant oasis, bears but slight resemblance to the desert overlooked by the botanical laboratory near Tucson. Here considerable variety of vegetation prevails; in the streams and river aquatic plants flourish; along the river banks rise poplars and willows; on the alluvium of the "flood-plain" is mesquite-forest, in which acacias and another leguminous species, *Prosopis velutina,* live side by side with elder-trees and ash-trees; approaching the hills other types of vegetation appear in the dried water-courses, and on the gravelly and sandy slopes, in both of which sites grows the notorious creosote-bush (Larrea); while on the hills are found yet other plant-communities, including giant cacti and Fouquieria. In the winter and summer seasons of rainfall—scanty though this be—the scene changes like magic, for thousands of short-lived annual (ephemeral) herbs spring up and clothe the ground with fresh verdure that contrasts with the ashen or bluish-green tints of the bushes or bizarre succulents.

Variety of water-supply, of slope, and of soil (clay, gravel, sand, alluvium, hard pan, saline spots) evoke corresponding variety in the vegetation of this patch of desert, and render the site eminently suitable for a botanical laboratory and for the solution of ecological and physiological problems by observations and experiments on desert plants in their natural surroundings.

Desert plants are exposed to the danger of death from desiccation by reason, first, of the various intense climatic factors tending to cause excessive evaporation, and, secondly, by the scantiness of the water available for absorption by the roots. Hence even where water is abundant in the soil, as is the case near rivers, atmospheric factors militate against luxuriance of growth or multiplicity of species. In less moist soil desert-plants evade or withstand the danger of desiccation by their possession of peculiar characters that may be physiological or morphological and anatomical.

As regards physiological peculiarities, the desert plants that are capable of reviving after thorough desiccation are few in number and are limited to lowly organised types, such as lichens (yet these by no means lack protective arrangements, as is indicated in Dr. Fink's article on lichens in the volume under review). On the other hand, many flowering plants exhibit in their life-history a rhythm that enables them to thrive in the desert without the aid of any adaptive structural features. For instance, in deserts there are many ephemerals that spring up in the rainy season, and within a few weeks produce leaves, flower and fruit, and die. They evade the true desert conditions, and survive in virtue of their rapid completion of the life-cycle at a definite season.

FIG. 1.—Right side of gulch near Laboratory, with generally south exposure.

In the Egypto-Arabian desert there is but one annual rainy season, namely, in winter, and consequently only one annual crop of winter-ephemerals. Near Tucson, however, there are two rainy seasons—in winter and summer respectively—and corresponding crops of winter-ephemerals and summer-ephemerals. These two plant-communities consist of entirely different sets of plants, the seeds of which (according to the information in this volume) will not germinate at the particular rainy season during which they are wont to be inactive.

The structural characters enabling desert plants to exist have been dealt with by Volkens and other investigators, and additional details have more recently been supplied by workers at the Tucson laboratory. But the main value and novelty of the work conducted in connection with this laboratory lies in the investigation of the behaviour and physiological activity of representative species, also in the thorough

[1] "Distribution and Movements of Desert Plants." By V. M. Spalding. Pp. v+144. (Washington: Carnegie Institution, 1909.)

analysis of the conditions prevailing and determining the precise local distribution of species and communities, including the changes taking place in the arrangement of the vegetation by colonisation and invasion.

In the various sections of the volume under review, interspersed in the discussion of general principles, we find many interesting details regarding certain species that we can piece together. For instance, we learn that the giant cactus, *Cereus giganteus*, which raises its fluted columnar stem up to a height of fifty feet, was shown by Mrs. E. S. Spalding to act as a vast expanding and contracting reservoir, as its ribs and furrows permit of bellows-like action. This plant, like some other desert-plants, possesses extensive shallow roots, which are very efficient collectors of water derived from feeble showers; for Mrs. Spalding found that after a rainfall of 0·5 inch "the stems expanded steadily for three weeks." Such a slight fall of rain would cause an appreciable increase in moisture only to a depth of less than four inches, so that the utility of shallow roots is clearly demonstrated, although so many desert plants have extraordinarily deep, relatively unbranched roots. In connection with the question of water supply, Dr. Livingston, in his valuable article on the soils, shows by means of curves that the effects of atmospheric precipitation on moisture in the soil regularly "lag" behind the actual falls of rain, so that, with certain depths of root, the plant does not immediately profit by showers, nor does it suffer, *pari passu* with absence of rain, from lack of supply of water. To return to the consideration of *Cereus giganteus*, Mr. J. C. Blumer clearly shows that individuals of this species, as of certain others, are more numerous on the southern slopes of hills. Inasmuch as other species show a preference for the more favourable northern slopes, there is a difference in the vegetation of the different sides of hills or gulches; and it is shown that on the northern side of the latter the difference tends to become accentuated with time, because the more numerous individuals and species present tend to cause an accumulation of humus and a consequent amelioration of the soil.

FIG. 2.—Left side of gulch near Laboratory, with generally north exposure.

The section of the volume dealing with the geology of the desert, written by a geologist, Prof. Tolman, seems in subject-matter rather out of place, as it abounds in diffuse and irrelevant generalities. Among these the statement that "Europe is behind America in the study of these newer phases of geology" would perhaps have been nearer correctness a dozen years ago.

One chapter differing from the others in being not particularly applied to Tucson desert is that on the origin of desert floras, written by Dr. D. T. MacDougal, who deals rather with the possible mode of evolution of biologic types than with the origin of the desert flora. He affirms that consideration of the known facts "leads to the inevitable conclusion that the form-characters, moisture-conserving capacities and resistance to desiccation, distinction of xerophytic species, must have made their appearance within comparatively recent geologic time." In the light of the geological evidence suggesting the former existence of deserts, and in view of the difficulty of geological preservation of the remains of desert-plants (except in oases or by rivers), such a conclusion seems open to the gravest doubt; and scepticism as to its correctness will be heightened by our knowledge, not only of the existence of xerophytic Cryptogamia and Phanerogamia of all ranks, but also of the distribution of such remarkably isolated types of desert plants as Welwitschia and Acanthosicyos. An additional consideration militating against Dr. MacDougal's conclusion is that xerophytic characters are evolved with considerable facility, as is demonstrated by the fact that various xerophytic communities (in deserts, for instance) in different parts of the world generally include a relatively large number of endemic forms that are definitely allied to and derived from the adjacent non-xerophytic flora.

In congratulating Mr. V. H. Spalding and his collaborators on this valuable contribution to our knowledge of the ecology of desert-plants, and on supplying ample justification for the foundation of a desert laboratory, we may perhaps be forgiven for adding a prayer to American botanists that when they use local or popular names of plants, they will, at least on first mention of these, also give the botanical names. The omission of this precaution causes botanists of other countries to lose more than time in the endeavour to learn what plant is being referred to. For instance, early in the volume under review, reference is made without any explanation to the "sahuaro," the "creosote-bush," "cotton-woods," the "ocotillo"; yet few, if any, European botanists would know the identity of all these, or that these names represent respectively *Cereus giganteus*, and species of Larrea, Populus, and of—the reviewer imagined that he remembered the generic name of the last, but has been compelled to interrupt this sentence and waste ten minutes in fruitless search.

PERCY GROOM.

NUBIAN ARCHÆOLOGY.[1]

THE first publication of the Egyptian Department of the Pennsylvania University Museum, under the direction of Prof. Randall Maciver, is one that shows great promise for the future. Thanks to the enlightened financial support of Mr. Eckley B. Coxe,

[1] "Areika." By R. Randall Maciver and C. Leonard Woolley. With a chapter on Meroitic Inscriptions. by F. Ll. Griffith. Pp. 56+plates (Oxford: Letterpress and Plates printed by Horace Hart at the University Press, 1909.) Price 1l. 1s. net.

jun., Prof. Maciver has been enabled to initiate a programme of archæological exploration in Egypt which, if continued, will, under the leadership of this most competent archæologist, undoubtedly result in interesting and important discoveries.

Prof. Maciver has chosen for the scene of his work a portion of the Nile valley which has hitherto seemed most unpromising, the barren Nubia that lies between the first and second cataracts. The nature of the country, in which the river flows practically through desert, with only the narrowest fringe of cultivation along its banks, seemed to deny the possibility of any important ancient centre having been established there, and the temples that were erected by the river-side seemed to be the memorials more of Egyptian imperio-religious pride than of real civilising energy. There is little doubt that no serious attempt to seek for remains of antiquity in this region would have been made even now had it not been for the fact that the proximate raising of the level of the Aswân Dam threatened the drowning of the ancient banks for a considerable distance upstream, and the consequent destruction of any historical evidence that might be buried near them. The attention of the Service des Antiquités, the archæological branch of the Egyptian Public Works Department, was at once directed to the necessity of saving such historical evidence so far as possible, and the director-general of the Service, Sir Gaston Maspero, K.C.M.G., commenced the organisation of a general archæological campaign in Nubia. Mr. A. E. Weigall, the inspector of antiquities for Upper Egypt and Nubia, undertook a preliminary tour of his Nubian district, which resulted in the publication of a careful and detailed report on the archæological probabilities and possibilities of Nubia. Then the Survey Department started a thorough and comprehensive exploration of the whole district (including excavations under the direction of Dr. Reisner and Mr. Firth, which began its labours at Shellal, and is now slowly working southwards).

Independent explorers were also summoned to the work. Prof. Garstang, of the University of Liverpool, carried out a season's work at Koshtamneh which was productive of interesting results. Unluckily, it has remained a *ἅπαξ λεγόμενον*. Prof. Garstang was drawn aside from the comparatively dull antiquities of Nubia to the more beautiful trophies to be found in the necropolis of Abydos, but he has now turned again southwards, to the Sudan, and time may yet bring him back to assist the researches of Mr. Firth and Prof. Maciver in Nubia. Prof. Maciver was last in the field, but has already made most interesting finds, which are described in "Areika," the volume under review. Assisted by Mr. C. Leonard Woolley, he has explored the region between Korosko and Amada, known as El Righa or Areika, which gives its name to the book. Here he has carried out three excavations; first, that of the castle of a Nubian chief of the time of Thothmes III., near Amada; secondly, that of a neighbouring cemetery of earlier date; thirdly, and most important of the three, that of a cemetery of Roman date at Shablul, opposite Korosko.

Nubian Castle near Amada: Period of Thothmes III. View looking from the North-east Corner. From "Areika."

The Nubian chief's castle is a queer conglomera-

ion of buildings of absolutely non-Egyptian and nore or less negro type, showing all the negro's inability to think out or carry out a coherent plan, or roduce any sensible building bigger than a simple ut. There is little doubt that the Nubian population s, and has always been, fundamentally negroid, and o doubt in ancient Egyptian days it was nearer he negro than it is now. The cemetery might, from he nature of the antiquities found in it, be dated to period contemporary with the Egyptian predynastic eriod. But Prof. Maciver well points out that the arbaric culture of the Nilotes, which was raised and rganised into a civilisation in Egypt before the beginning of the First Dynasty, continued in its primiive form in Nubia throughout history, and even now ottery not distantly akin to the prehistoric Egyptian s still made there. So that we cannot say that rimitive remains in Nubia are necessarily primeval n date. This explains the phenomenon of the "Pan-Grave People" of the XIIth Dynasty in Upper Egypt. The isolated Egyptian settlements of this eople, whose pottery is so closely analogous to that of the primitive Egyptians, but whose "Middle Kinglom" date is certain, were originally dscovered by Prof. Flinders Petrie. They remained an enigma ntil Mr. Weigall discovered that the earlier Nubian emeteries were largely of "Pan-Grave" type, and hat "Pan-Grave" pottery was common there. It vas then supposed that the Egyptian "Pan-Grave" emains were the relics of Nubian conquerors t the time of the XIIth Dynasty. Prof. Maciver, following up the clue, supposes in the present volume hat the Egyptian "Pan-Grave" people were Nubian otters imported into Egypt to make their special ottery (which was, in its way, finer than that of the Egyptians). To me it seems more probable that they were not merely potters, and I would see in them simply colonies of deported Nubians, brought back by the conquering Pharaohs of the XIIth Dynasty as he "living prisoners," trophies of their Nubian razzias which are often mentioned in the inscriptions, and settled in vacant lands of Upper Egypt.

The discoveries at Shablul are of importance as lefinitely identifying the products of a peculiar art, long known and correctly identified as of Roman date (it is especially well represented in the collections of the British Museum), as Nubian. The later specimens of the painted pottery of this style clearly connect on to the crude productions of the Coptic potters, and this was always seen, but Prof. Maciver and Mr. Woolley have shown that the same style, which is Nubian only, goes back well into the Ptolemaic period. Its earlier products are quite Egyptian or Greek in the choice of motives, but throughout the whole series there runs a note of peculiar originality of treatment which can only be due to the Nubian potter himself. This painted pottery is splendidly illustrated by coloured plates which accurately reproduce the originals. Its decoration is extremely interesting, and the comments of the authors themselves on it are most illuminating. But to quote the opinions on it of professors of artistic style who are evidently not gifted with much historical sense was unnecessary: Prof. Meurer's opinion that a certain design of a crescent with a cross (a modification of the *ānkh*, the symbol of life) on this Roman-Nubian pottery is a descendant of the Minoan Cretan motive of the Double Axe above the Horns of Consecration (so well known from Dr. Evans's discoveries at Knossos) is, frankly, absurd, and we wonder that our authors did not pass over it n respectful silence. As it is, their reviewers have to chronicle it with disrespectful mirth.

Prof. Meurer has supposed that the two designs are connected because they are alike, ignoring the absence of all known connecting links between them during the space of a millennium and a half. The only possibility of the Nubian design being descended from the Cretan would lie in an Egyptian adoption and naturalisation of the Cretan design in the time of the XVIIIth and XIXth Dynasties; and though the Egyptians did for a time take over some Cretan artistic ideas, they never took over the idea of the Double Axe above the Horns of Consecration; and naturally they did not, because they did not take over the worship of the Cretan gods, whose symbols these were (though cults akin to those of Crete may have been known in the Delta at an early period). We prefer our authors' own ideas without those of Prof. Meurer. Throughout their work they themselves had made only one remark which calls for criticism—the description of the *ānkh,* the symbol of life, as the "Nile-key." The *ānkh* was not a key, and had nothing to do with the Nile. It was a conventional representation of a man's girdle, with the tied ends hanging down in front.

The book concludes with a paper on the inscriptions in "Meroitic" form of the Demotic script, of which many specimens were found by the explorers, and its relation to the Meroitic hieroglyphic inscriptions, by Mr. F. Ll. Griffith. Mr. Griffith here makes the first step to a decipherment of both scripts, and has established several curious and unexpected facts with regard to them. This discussion of the relation of their language to the Nubian of Christian times, lately studied by Profs. Schäfer and Schmidt, is very suggestive.

In conclusion, Messrs. Maciver, Woolley, and Griffith must be congratulated on the production of a most interesting contribution to a little-known branch of Nilotic (if we may not, strictly, say Egyptian) archæology.

H. R. HALL.

FROM THE CAPE TO CAIRO WITH A MAGNETOMETER.

DURING the last twenty years a great many observers have carried on magnetic work in different parts of Africa. A summary of the results up to 1900 at the Cape of Good Hope has been collected and published by Prof. Morrison and the writer,[1] and one for Northern Africa by Mr. B. F. E. Keeling;[2] since 1898 a magnetic survey of South Africa has been in progress; between that date and 1906 observations were taken at more than four hundred stations by Prof. Morrison and the writer, with assistance at one time and another from Mr. S. S. Hough, Prof. A. Brown, Prof. L. Crawford and Mr. V. A. Löwinger. A report by the present writer on the work during this period, including a summary of the earlier work in Africa, south of the Zambezi, was published for the Royal Society at the Cambridge University Press.[3]

Notwithstanding the considerable amount of work done, there was, and still is, a lack of magnetic data for great tracts of what is now no longer geographically the unknown continent. With the purpose of obtaining some information in parts magnetically unknown, the writer submitted, in 1907, a scheme of work through Dr. L. A. Bauer, director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, to the trustees of that body. In this scheme he proposed to continue the line of magnetic stations already occupied between Cape Town and the Victoria Falls to Gondokoro, on the Nile. North of that it was not deemed necessary to observe, as the Survey Department of the Egyptian Government had already put forward proposals for a

1 "Magnetic Elements at the Cape of Good Hope." By Beattie and Morrison. (Trans. S.A.P.S., vol. xiv., 1903.)
2 "Magnetic Observations in Egypt." By B. F. E. Keeling. (1908.)
3 "Report of a Magnetic Sunvey of South Africa." By J. C. Beattie. (1909.)

magnetic survey of Egypt and the Sudan. It was intended also, should time permit, to make observations in German South-west Africa.

These proposals met with the approval of the trustees of the Carnegie Institution, and they allocated a sum of 200*l.* for the work. In the first instance the proposals contemplated only one field-party with one observer; later, however, the writer modified his plan so as to include a second observer, in the hope of being able to have two field-parties. At his suggestion the Department of Terrestrial Magnetism in Washington appointed Prof. Morrison as second observer. The additional money necessary was provided by the Government Grant Committee of the Royal Society (250*l.*), and by Dr. L. S. Jameson and Sir Lewis Michell (100*l.*)

The work began at the end of November, 1908, when the writer left Ceres Road, in the Cape Colony, for Windhuk, in German South-west Africa. This journey lasted four months. During February and March of 1909 Prof. Morrison made observations along the railways in the northern part of the same region.

In April, 1909, repeat observations were made in Cape Colony and in Rhodesia, and Prof. Morrison also made observations between the Victoria Falls and Broken Hill, the then terminus of the Beira and Mashonaland Railways.

The two observers left Broken Hill in the beginning of May, and marched to Abercorn *viâ* Fort Rosebery. After Broken Hill the only means of transport was by porters; one set of instruments was carried from there more than 2000 miles, the other more than 1400, the whole distance being accomplished without mishap to any of the instruments.

At Abercorn the observers separated: Prof. Morrison proceeded to the northern end of Lake Nyasa, then down the Nyasaland plateau and the Shiré and Zambezi valleys to Chinde; from there he went by sea to Dar-es-Salaam, and made observations between it and the terminus of the railway which goes from that place inland. He was able to secure a number of observations which will be of great value for determining the secular variations of the magnetic elements in that part of the world. Finally, he made a number of observations along the Uganda Railway from Mombasa to Port Florence.

The writer went overland from Abercorn to Bismarckburg, a German station on the south shore of Lake Tanganyika. From there he marched to Tabora, an important town in German East Africa; observations could not be made along the shores of Tanganyika, as he had originally intended, because the steamer had temporarily ceased to run—the two white men on it, the captain and the engineer, having contracted sleeping sickness. From Tabora he journeyed overland to Bukoba, a German port originally founded by Emin Pasha, on the west shore of Victoria Nyanza; the march was continued along the west coast of that lake to Entebbe. At the latter place he found it was impossible to take the usual overland route to Gondokoro, on account of sleeping sickness; his caravan had to go *viâ* Albert Nyanza, and there be conveyed forty-five miles from Butiaba to Koba. The end of the porter transport was reached at Gondokoro, just a little more than 2000 miles from Broken Hill by the route followed. The work was brought to a close by the two observers once more meeting at Cairo, and comparing their instruments with those at Helwan and, finally, with those at Kew.

In addition to the observations taken along the routes mentioned above, a number of stations previously worked at in Cape Colony, the Transvaal, Natal and Zululand were again occupied in 1908; the cost of this was defrayed by a grant from the Royal Society (25*l.*) In all about 360 new stations were occupied, mainly in regions which formerly wer known magnetically only slightly or not at all.

The instruments used for the above observations wer the same as in the earlier work in South Afric (1898–1906), and were lent to the writer by the Roya Society, the Royal Observatory of the Cape of Goo Hope, and the South African College. By means o the repeat observations, the results obtained in 190 and in previous years can be reduced to the sam standard; and, further, through the comparisons a Helwan and at Kew, can be compared with muc that has been done in recent years in other parts o the world.

While making the preliminary arrangements for th journey, the writer received great assistance from th Governor of the Colony of the Cape of Good Hope Sir Walter Hely-Hutchinson, who communicated wit the authorities of the various territories it was pro posed to survey, and obtained permission for th observers to enter them, and to enjoy while ther special privileges.

In German South-west Africa the authoritie allowed the observers to travel free of charge over th Government railways; the same facilities were give by the Cape, the Central South African, the Natal the Rhodesian, and the Uganda railways; the write had valuable concessions while travelling in the Suda and on the Egyptian Government steamers and rail ways.

In addition to these facilities, the courtesy and hos pitality of the English and the German officials di much to relieve the tedium and strain incident to worl of this nature in such circumstances. The writer feel that a formal recognition such as this is but a poo return for the help so willingly and generousl accorded.

In conclusion, it gives the writer great pleasure t have the opportunity of thanking Mr. R. S. Wood ward, the president of the Carnegie Institution, an Dr. L. A. Bauer, director of the Department of Terres trial Magnetism of that institution, for their advice an encouragement during the progress of the work, an in particular to thank the latter for the great interes he has taken in the reduction of the results, a worl which is being carried out at Washington under hi direction.

J. C. Beattie.

SIR ROBERT GIFFEN, K.C.B., F.R.S.

THE sudden death of Sir Robert Giffen on th morning of April 12, while on a tour in Scot land accompanied by Lady Giffen, is a great loss t economic and statistical science. He joined the Statis tical Society in 1867, at the age of thirty, having the already acquired reputation as a writer on financia subjects in the *Globe*, the *Fortnightly Review*, th *Economist*, and the *Spectator*. He was elected member of the council and one of the secretaries c the society in 1876, in which year he joined the Civ Service, and was appointed chief of the Statistica Department of the Board of Trade, and one of th delegates of the Government of England to the Inte national Statistical Congress at Buda-Pest. He sul mitted to that congress "Considérations sous Form de Tableaux pour la Préparation d'une Statistique ir ternationale des Chemins de Fer," and was appointe a member of the permanent committee. To the Socia Science Congress at Liverpool, in the same year, h contributed a paper on the causes and effects of th depreciation of silver, how far is it an evil, and wha are the means of remedying the evil? In his officia capacity, he devoted himself with zeal to rectifyin and harmonising governmental statistics, and t diminishing the overlapping and cost of parliamentar returns. For example, he pointed out that the stati

tics of emigration were vitiated by the omission of any deduction in respect of the return of persons temporarily leaving the country; and he induced the Government to appoint a committee to consider the whole question of official statistics.

In 1878 he read before the Statistical Society an important paper on recent accumulations of capital in the United Kingdom, which is an excellent example of the comprehensiveness and accuracy of his statistical methods, and of his faculty of drawing trustworthy inferences from materials that at first sight appear insufficient. Great as was the increase of wealth which he had to record, he was sanguine enough to hold that it would be the fault of the English people if their progress were not in future even more rapid than in the past, and his forecast has been verified. In the same year he took part in the foundation of the *Statist* newspaper, and was the delegate of the Government to the International Statistical Congress at Paris.

In 1879 he contributed to the Statistical Society a treatise on the fall of prices of commodities in recent years, and undertook the duty of editor of the society's journal. The Treasury committee on statistics made its report, to which was appended an important memorandum by Sir Robert Giffen on the compilation and printing of the statistics of the United Kingdom. In 1882 he read a paper to the Statistical Society on the use of import and export statistics, and was elected president of the society. His inaugural address was on the utility of common statistics. In the following year the University of Glasgow, of which he had been a student, conferred upon him the degree of Doctor of Laws. His inaugural address to the Statistical Society for that year was on the progress of the working classes in the last half-century. It is characteristic of his thorough devotion to any duty which he undertook that he was present at every meeting of the society held during his presidency. In the year 1884 he was elected a member of the Athenæum club under the rule which enables the committee of the club to confer that honour on persons distinguished in literature or the arts or for public service. In 1885 he contributed to the Statistical Society's jubilee volume a paper on some general uses of statistical knowledge; and, in the following year, read to the society further notes on the progress of the working classes. In 1887 he was nominated by the International Statistical Congress at Rome as the English member of a committee on standards of value; and in the same year he was appointed by the British Association president of the section of economic science and statistics (section F) for the meeting at Manchester, and delivered an address on the recent rate of material progress in England. He also took part in the proceedings of a committee of the association appointed to investigate variations in the value of the monetary standard, and in the following year drew up the report of that committee. He afterwards became its chairman.

In 1890 Sir Robert Giffen took part in the formation of the British Economic Association, now the Royal Economic Society, and became a vice-president of it. In 1891 he was created a Companion of the Bath, and in 1892 elected a Fellow of the Royal Society. In 1894 the Royal Statistical Society (as it had then become) paid him the well-earned compliment of awarding him their Guy medal in gold as a recognition of his great services. In 1895 he took the second step in the ladder of the Order of the Bath, being promoted to the dignity of Knight Commander, and in 1897 he retired from the public service after a career of great usefulness and distinction, having taken a large share in the creation and development of the labour, commercial and statistical departments, of which he was the first controller-general. In 1900 he was elected president of the Manchester Statistical Society, and delivered an address; and in 1901 the British Association appointed him, for the second time, president of section F, and he delivered an address at Glasgow on the importance of general statistical ideas.

His separate published works were:—"American Railways as Investments" (1872), "Stock Exchange Securities" (1877), "Essays in Finance" (3 editions), "The Case against Bimetallism" (2 editions), "Economic Inquiries and Studies" (2 vols., 1904).

This formal record of a life spent in the study of subjects usually thought to be dry and uninteresting would not be complete if it were not supplemented by the statement that in personal character and private life he was one of the most genial of men.

NOTES.

The eighteenth "James Forrest" lecture of the Institution of Civil Engineers will be delivered at the institution on Wednesday, June 22, at 8 p.m., by Sir John Gavey, C.B., his subject being "Recent Developments of Telegraphy and Telephony."

A Reuter message from Washington states that the proposed American Antarctic expedition under the joint auspices of the Peary Arctic Club and the National Geographic Society has been abandoned for this year on account of lack of funds.

We learn from *Science* that Prof. R. P. Whitfield, curator in the American Museum of Natural History since 1877, and the author of important contributions to palæontology and geology, died on April 6, at the age of eighty-two years.

The death is announced, at sixty-one years of age, of Dr. C. B. Plowright, formerly professor of comparative anatomy and physiology at the Royal College of Surgeons, and the author of a standard work on fungi.

M. de Montefiore, we learn from the *Revue scientifique*, has given 150,000 francs to the Paris Academy of Sciences to create a new triennial prize of 12,500 francs to assist the progress of electrical science.

It is announced in the *Times* that a National College of Agriculture is soon to be established in Pretoria. General Botha has promised to set aside 100,000*l.* as a first instalment for the execution of the project, and the Town Council has unanimously decided to give the Government the whole of the town lands of Groenkloof as a site. The area comprises 3681 acres, and contains arable and pasture lands as well as a large plantation.

The Geological Society of France has this year awarded its Danton prize to M. Gosselet. The prize is given to the geologist whose discoveries are likely to benefit industry most, and was awarded to M. Gosselet for the part he has taken in the development of coal-mining in the north of France. The Viquesnel prize, intended to encourage geological research, has been awarded to M. Robert Douvillé for his stratigraphical work on the geology of Spain and his palæontological researches on the foraminifera and ammonites.

The Geologists' Association has arranged a Whitsuntide excursion to Swanage, Lulworth Cove, and Bournemouth from May 14–18. The party will leave Waterloo on Friday, May 13, at 4.10 p.m. The excursion to Lulworth Cove will be carried out only if the sea is calm, and

should May 14 not be suitable for the excursion, the Lulworth visit will be postponed to May 18. Full particulars of the excursions can be obtained from Mr. W. P. D. Stebbing, 78a Lexham Gardens, London, W.

An event of importance in wireless telegraphy is the inauguration by the Marconi Company of a service for the direct transmission of public messages between their stations at Clifden, in Ireland, and Glace Bay, in Canada. Both the stations have been recently reconstructed, and communication will be kept up by them continuously both by day and by night. The latter fact is interesting as showing that the difficulties of transmission during the hours of daylight have been overcome. The system is a directive one, the aërials being so constructed as to emit waves principally in the required direction. The discharger used is of the type invented by Mr. Marconi, in which sparking takes place between metal discs cooled by being kept in rapid rotation. By causing the sparks to be formed between equally spaced projections on the discs, the trains of waves emitted are broken up in a regular manner so as to produce in the receiving telephone a musical note which can be clearly distinguished by the operator. The power used for sending is about 400 kilowatts. The service commenced on April 23 by an interchange of greetings between the Postmasters-General of Canada and Great Britain.

The present spring is proving peculiarly free from spells of really warm weather, and the summary of temperature issued by the Meteorological Office with its Weekly Weather Report shows that for the period of seven weeks ended April 23 the thermometer in the screen did not exceed 64° in any part of the United Kingdom, the highest readings ranging between 60° and 64°. At Greenwich there have, as yet, only been six days this year with a temperature of 60° or above, whilst to the same date last year there were eighteen days with a temperature of 60° or above. The rainfall for the first half of spring is less than the average in all districts, except in the north and east of Scotland and in the south-east of England, the greatest deficiency being 1·08 inches, in the south-west of England. Since the commencement of the year, however, the rainfall is everywhere in excess of the average, and in seven out of twelve districts the excess is more than 2 inches. The mean sea temperature round the British Islands is at present nearly everywhere colder than at the corresponding period last year, and at Kirkwall it is nearly 5° colder.

Thanks to the energy of Mr. C. E. Fagan, and the generosity of owners, a remarkably fine and representative series of trophies illustrating the big game of the Empire has been brought together and dispatched to Vienna for the forthcoming Sports Exhibition. The specimens lent by the Prince of Wales include the record head of the Javan rusa from Mauritius (where the species has been reduced), together with heads of tahr, markhor, musk-ox, and Newfoundland caribou. The Duke of Westminster is sending a magnificent Irish elk skull; Lord Burton an unrivalled twenty-pointer Scots stag; Lord Lamington a pair of Indian lion skins; Captain Collins, of the Wau Garrison, a head of a bull Sudani eland (one of three or four in this country), and Mr. F. C. Selous one of the last really fine heads of the typical South African white rhinoceros.

For the purpose of publishing the practical and scientific results obtained through the medium of the Entomological Research Committee (Tropical Africa), it is proposed to issue a journal, to be called *The Bulletin of Entomological Research*. The journal will contain accounts of the observations which have any bearing on the subject of economic entomology; descriptions of insect life-histories, with figures of their earlier stages; reports on practical methods for destroying or keeping in check any noxious species; papers by specialists dealing with the systematic classification of such groups as are known to be, or are likely to be, injurious to human beings, live-stock, or agriculture; and so forth. It is proposed to issue not fewer than four parts annually, and additional parts will be published whenever sufficient material is forthcoming. Further particulars may be obtained from the scientific secretary, Entomological Research Committee, British Museum (Natural History), Cromwell Road, London, S.W.

The report of the council and the proceedings of the Hampstead Scientific Society for the year 1909 show that the society has completed ten years of useful work. During the year with which the report deals, an astronomical observatory and meteorological station have been established on the top of Hampstead Hill. The Metropolitan Water Board allows the use for the purposes of the observatory and station of a portion of the surface of the covered reservoir near the Whitestone Pond. Arrangements have been made for the meteorological records to be taken twice daily, and the results are published in the monthly return of the Meteorological Office and in the *Hampstead and Highgate Express*. We notice that Sir Samuel Wilks, Bart., F.R.S., has been compelled, through advancing years, to resign the presidentship of the society, and has been succeeded by Prof. W. M. Flinders Petrie, F.R.S. The membership of the society now numbers 274.

Dr. Julius Kühn, professor of agriculture at the University of Halle, whose death was announced in these columns last week, was one of the band of workers who laid the foundations for the modern development of the scientific side of agriculture. He acquired a great practical knowledge of the subject in his early days when working as a farmer and, after his student days at Bonn were over, as manager of a large estate. This knowledge proved invaluable when, later on, he was appointed to Halle and devoted himself to the more scientific aspects of his subject. Perhaps his best known work is that in connection with the feeding of animals. It had for many years been customary to compare animal foods with one another in terms of "hay equivalents." The method was necessarily rough, and capable only of limited development. In 1859 Grouven introduced feeding standards based on the amounts of the various food constituents—protein, carbohydrate, &c.—required by the animal; knowing these data and the percentage composition of the foods, it was possible to make up rations suited to the different classes of stock. So attractive was this new view that a tendency arose to regard the feeding of animals as a merely arithmetical problem requiring only a knowledge of the standards and of the composition of foods. Kühn, however, insisted on the necessity of keeping the new work down to the solid ground of fact. Whilst recognising the value and importance of the standards, he also recognised the individuality of the animal and of the crops on which it feeds. His book "Die zweckmässigste Ernährung des Rindviehes," which appeared in 1861, and went through ten editions in the course of thirty years, thus had a steadying effect on the development of the subject. He also published a number of papers on the parasitic diseases of plants, and is remarkable for his early advocacy of the view that sugar-beet "sickness" is the result of nematodes, which can be destroyed by burning over the ground. His activity

was great, and he continued publishing some of his manurial results even after the celebration of his eightieth birthday on October 23, 1905.

IN *Revue des Idées* for March M. L. Bréhier, under the title of "Les Origines de l'Art musalman," discussing the recent investigations of MM. H. Saladin and G. Migcon, shows that Mohammedan art is not the result of a "sudden improvisation." It is due to the development by conquered races, Copts, Syrians, people of Mesopotamia, and Greeks, of ideas surviving from the Chaldæan-Assyrian periods, and, particularly in its repulsion against delineation of the human form, was a protest against Hellenism.

MUCH work has of late been done on the action of various organic arsenic compounds as trypanocides. Drs. R. P. Campbell and J. L. Todd find that arseno-phenylglycin is a more active trypanocide than atoxyl in the treatment of experimental infections of white rats by the *Trypanosoma brucei* (*Montreal Med. Journ.*, xxxviii., 1909, p. 795).

IN the Journal of the Royal Army Medical Corps for August, 1909, Mr. P. D. Strachan and Lieut.-Colonel C. Birt summarise observations on the occurrence of Malta fever in South Africa. The disease has been met with in Orange River Colony, in Hanover, Beaufort West, Kimberley, and Steytlerville, Cape Colony, and in Bechuanaland, and there is a widespread epizootic of Malta fever among the goats of South Africa.

THE *Philippine Journal of Science* for October last (iv., No. 5), which has only recently come to hand, contains matter of considerable medical interest. An attempt to extend the cutaneous reaction, which has been much used in tuberculosis, to leprosy, is reported by F. Calderon and V. G. Heiser. Fifty lepers were vaccinated with a glycerin extract made from excised leprous nodules. In two or three cases there was a doubtful reaction, but otherwise the vaccinations were in all respects like controls done with a glycerin extract of skin from a cholera patient. The filtration of immune sera (anti-tetanic and anti-diphtheritic sera) is the subject of a paper by E. H. Ruediger. The serum was passed through Berkefeld filters, and the filtrate was found to be just as active as the unfiltered serum.

THE issue of the *Philippine Journal of Science* for November, 1909, vol. iv., No. 6, is entirely devoted to systematic zoology, Mr. A. Seale describing a large number of species of fishes as new, while Mr. C. S. Banks names four new Culicidæ and commences a list of the Rhynchota of Palawan, and Mr. L. Griffin communicates a synopsis of the snakes of the same island.

THE April number of the *Journal of Conchology* contains Colonel Godwin-Austen's presidential address to the annual meeting of the Conchological Society in October last, in which emphasis is laid on the importance of a study of the soft-parts of land molluscs as the only means of determining the affinities of the various forms. Some interesting lines of evolution which have been worked out by these means in the Zonitidæ are quoted.

IN the *Entomologists' Monthly Magazine* for June, 1909, Mr. E. A. Newbery adduces evidence to show that the scolytid beetle described in 1834 by Westwood as *Hypothenemus eruditus*, on the evidence of specimens in an old book-cover, and since then generally included in the British list, is really an exotic species, one of the habitats of which is the shells of Brazil nuts, while it has also been observed in book-covers from Java and Singapore. It had previously been recorded from tropical America in the "Biologia Centrali-Americani."

THE March number of the *Museums Journal* contains a notice of the collection of Microlepidoptera, with the associated entomological library, recently presented by Lord Walsingham to the Natural History Branch of the British Museum. The collection, which contains about 45,000 species, against some 4000 previously in the museum, has been temporarily deposited in one of the new store-rooms at the base of the building, where it will gradually be arranged in proper order by the additional assistant specially appointed to take charge of it by the trustees.

IN addition to an account of the progress of that institution during the year, the *Aarsberetning* of the Bergen Museum for 1909 contains an illustrated description of the personal relics of Claus Frederik Fastings, which were bequeathed to the museum at his death in 1791. Of the three papers in the third part of the *Aarbog* of the same museum, by far the longest is one, by Mr. O. J. Lie-Pettersen, on the fresh-water rotifer-fauna of Norway. The author has been collecting material for several years, and records a long list of species; but, although it is stated that previously very little was known on the subject, it is remarkable that not a single one of these is described as new.

THE last number of the Journal of the Marine Biological Association of the United Kingdom (vol. viii., No. 5) contains a good example of the admirable work which is being carried on at the association's Plymouth laboratory. The director of the laboratory, Dr. E. J. Allen, and Mr. E. W. Nelson, have been engaged for some years past in experimenting on the cultivation of diatoms as food to be used in the rearing of various types of marine larvæ. By the use chiefly of modifications of Miquel's methods they have been able to make, by the addition of certain substances to sterilised sea-water, nutrient solutions in which it is possible to produce "persistent cultures" of a single species of diatom, or mixed cultures containing several species. In these cultures the diatoms multiply rapidly, and continue to thrive for long periods, sometimes extending over many months. The larvæ to be reared are placed after hatching in pure sterile sea-water; a sufficient amount of the nutrient solution is added, if necessary, and the water is inoculated with a suitable culture of diatoms; in some cases other unicellular organisms were used. By this means larvæ of Echinus were reared until long past the metamorphosis, being fed in the earlier stages upon the actively growing unicellular organisms, and after the metamorphosis on red seaweed. Larvæ of a sea-cucumber (Cucumaria) and a worm (Pomatoceros) were also successfully reared, and the method promises to be of great value to the experimental embryologist.

THE controversy between Dr. Florentino Ameghino and his critics respecting the alleged human origin of the "burnt earths" of Argentina was commented on in NATURE, vol. lxxxi., p. 534. The last paper then noticed was dated February 17, 1909. Since then, Ameghino has issued four others, up to March 19 of the present year; but it will be well now to await the elaborate memoir which is promised, and in which the evidence of hearths with bones of animals used as food will be set forth. The

strong point about Ameghino's spirited and persistent defence is that he now makes it clear that he has studied thin sections of the earths and of numerous artificially prepared products. It is admitted on all hands that minerals from decomposed lavas abound in the Pampas earths, and thus would occur undestroyed in the products of their partial fusion. This was pointed out in the previous notice in Nature, and the thoroughness of Ameghino's reply is shown by his references to this notice, and his correction of some of its statements, in his "Examen critique du Mémoire de M. Outes". (*Anales del Mus. Nac. de Buenos Aires*, 1909, p. 459). While Ducloux, and perhaps our own reviewer, seem allowed some saving grace, the work of Outes is said to contain "des hérésies scientifiques tellement colossales que personne ne peut croire qu'il les ait publiées de bonne foi." A paper issued on January 29 (*ibid.*, tomo xx., p. 39) provides a very useful summary, with long quotations, of previous work on these debatable earths down to 1907, and a bibliography of work from 1907 to 1909.

Three new species of Echeveria from southern Mexico are described and figured by Drs. J. N. Rose and C. A. Purpus in vol. xiii., part ii., of the Contributions from the United States National Herbarium. It is suggested that two, *E. gigantea* and *E. subalpina*, will be found useful in horticulture as bedding plants.

Botanists who are contemplating a summer holiday in the Alps with the view of collecting choice plants will be interested in two articles by Mr. H. S. Thompson, published in the *Gardener's Chronicle* (April 16 and 23), giving an account of the flora of Mont Cenis. Among the plants taken between Susa and the Hospice were *Telephium Imperati*, *Cytisus supinus*, *Dianthus neglectus*, and *Saponaria lutea*. Around the small Lac Clair, a wonderfully rich hunting ground, situated at a height of 9000 feet, the author found *Campanula cenisia*, *Arabis coerulea*, *Cortusa Matthioli*, and clumps of *Saxifraga biflora*. Altogether Mr. Thompson collected 180 plants growing above an altitude of 8000 feet, besides meeting with a rich flora at lower levels.

A curious gall on the Indian grass *Ischaemum pilosum* is described by Mr. L. A. Boodle in the *Kew Bulletin* (No. 3). It takes the shape of a cylindrical tube about 15 cm. long, resembling a slender goosequill, which, with a few scale leaves at the base, arises as an erect branch from the creeping rhizome. The gall caused by an insect, *Oligotrophus ischaemi*, is considered to be a greatly elongated internode. Various illustrations are given, including figures of the transverse section of the solid normal and hollow modified stem. Reference is also made in a short note to a method of preparing baobab trees as water reservoirs in the Soudanese province of Kordofan. The trunk is hollowed out to form a cistern about 20 feet deep and 10 feet in diameter; then a shallow basin is prepared round the base of the tree for the collection of water during the rain, from which it is transferred to the hollowed trunk.

The annual report for 1909 of the Rothamsted Experimental Station is not so adverse as might have been expected considering the heavy rainfall and the low temperatures that prevailed through the summer. The yield and quality of wheat grain was poor, but the yields of barley and mangolds were above the average. A comparative test of nitrate of lime, cyanamide, nitrate of soda, and sulphate of ammonia, together with superphosphate in each case, was initiated with barley as the crop, which has yielded, so far, no practical difference in the results. The important investigations carried on by members of the staff in connection with the effect of partial sterilisation of the soil, the direct assimilation of ammonium salts by plants and the development of the wheat grain have already formed the subject of a reference in these columns.

The annual report for 1909 of the Woods and Forests Department of South Australia appears in Nos. 4 and 6 of the Agricultural Journal of that colony, and shows that the possibilities of the situation are being realised. It is said that inquiries have been made from America for one million railway sleepers cut from red-gum; the contract could not be taken up, because the supply of red-gum for sleepers is rapidly being used up for Australian railways, but it is of interest as showing that even the United States are having to look about for timber supplies. The expenditure of the Department has been increased from 10,080*l.* to 17,575*l.*; the intention is to encourage in every way the planting of pine, gum, and other trees, even to consider the advisability of offering a bonus sufficient to cover the cost of the necessary attention to the trees for the first four or five years of their existence. Wasteful methods of handling mature timber are still in vogue; we are told that only about one-third of the timber on any given area is properly utilised, the rest being destroyed by axe and fire owing to the unsystematic and wasteful character of the lumbering operations.

The marked increase of the sensitiveness of an instrument for detecting alternating currents of electricity when the free period of the instrument coincides with the period of the current was pointed out by Prof. M. Wien twenty years ago. The property has since led to the production of several forms of vibration galvanometer, and the theory of the instrument has to some extent been investigated. A more complete examination of the theory, and a comparison of the theory with the actual behaviour of three forms of the galvanometer, are to be found in a paper on the subject by Mr. F. Wenner in the February number of the Bulletin of the Bureau of Standards. A few new hints as to the design of the instruments are also given. In order to avoid giving the instrument a double period the moving system must be symmetrical. In bridge work the resistance of the galvanometer should be very much less than that of the bridge, and the back electromotive force developed in the instrument should be half that impressed on the galvanometer circuit.

The Jesuit Fathers at Zikawei are to be congratulated on the addition to their observatory of a seismological station. During the months of January and February this year a Weichert pendulum of 1200 kilos. recorded twenty-six shocks. Twelve of these were also noted by an Omori pendulum of 15 kilos. Both instruments record on smoked paper. The difference in the number of records obtained from these two types of instruments is undoubtedly striking, but had there been at Zikawei an apparatus which gave a photographic record of earthquake motion it is probable that the total number of shocks noted would have been more than doubled. During this period at Shide, in the Isle of Wight, photographic recorders of the British Association type noted eighty-one disturbances. An instrument writing on smoked paper at that station, however, only recorded a few of these.

In the second fascicule of vol. iv. (new series) of the *Annales de l'Observatoire royal de Belgique*, the geophysical results obtained at the observatory during 1908

are tabulated and discussed. The hourly values of the three magnetic elements are given in full with the times and values of the absolute maxima and minima, the differences, and the characters of the curves, morning and evening. Then follow valuable *résumés* in several forms, and lastly is given a series of notes directing special attention to the exceptional disturbances of the year, the curves for which appear amongst a number of excellent curves at the end of this section. Other sections deal with the solar observations—useful for comparison with the variations of the magnets—the soil temperatures at various depths, and the seismological records, making the work a valuable source of information to anyone engaged on geophysical problems. The previous fascicule of the same volume dealt with the material collected in 1907, and the index now published shows the contents of the volumes that have appeared, with interruptions, since 1834. In the preface M. Lecointe, the director, pays a fitting tribute to the conscientious and enthusiastic labours of Captain Louis Niesten, who, after thirty-two years' service, has retired from the observatory staff. Practically all the observations now published were made by M. Somville.

THE Wabash Railroad Company, U.S.A., was one of the pioneers in the use of reinforced concrete, and some of their methods of construction were described in a paper read at the Institution of Civil Engineers on April 19. This company commenced the use of this form of construction for bridges, culverts, subways, and retaining walls in 1902. Not any of these structures have required any repairs since they were built. They are very rigid under loads, and their appearance indicates that they will outlast any other kind of structure, and require no maintenance. Attempts have been made to determine the deflection in reinforced concrete structures due to train loads, but none can be detected under ordinary measurement. The unit stresses allowed are as follows:—for steel in tension, on net section of rod, 18,000 lb. per square inch; for steel, bond on deformed bars, 100 lb. per square inch; for concrete, compression in cross-bending, 800 lb. per square inch; for concrete, direct compression, 600 lb. per square inch; for concrete, shear (diagonal tension) in plain concrete, 30 lb. per square inch; for concrete, shear (diagonal tension) where the web is properly reinforced, 100 lb. per square inch. The concrete used consists of one part of Portland cement, two of sand, and four of stone or gravel. Prof. Talbot's rules were employed for proportioning the concrete and steel. The concrete was put in as a wet mixture, securing a more dense and homogeneous concrete, and imbedding the reinforcement better, thus preventing rusting of the metal.

MR. C. BAKER's classified list (No. 44, April) of second-hand instruments for sale or hire contains particulars of about 1600 pieces of scientific apparatus. The apparatus includes optical instruments of all kinds, and many other appliances and accessories required for instruction or research.

A SECOND revised edition of an excellent handbook, "Brazil in 1910," by Mr. J. C. Oakenfull, has just been issued by the author, 21 Clifford Terrace, St. Budeaux, Devonport. The work has been brought up to date, and is well illustrated by reproductions of photographs and several maps. There are many statistical details, and an appendix giving information as to salaries and cost of living. The main theme of the writer is that Brazil offers abundant opportunities for the activities of Europeans with capital.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN MAY:—

May 2. 4h. Mercury at greatest elongation (20° 55′ E.).
,, 8h. 32m. to 10h. 57m. Transit of Jupiter's Satellite III. (Ganymede).
4–7. Meteoric shower before sunrise from Halley's comet?
8. 17h. Sun eclipsed, invisible at Greenwich.
9. 11h. 59m. to 14h. 26m. Transit of Jupiter's Satellite III. (Ganymede).
10. 0h. Mercury 1° 18′ N. of the Moon.
11. 11h. 52m. Minimum of Algol (β Persei).
14. 8h. 41m. ,, ,, ,,
18. 14h. Halley's comet transits the Sun's disc.
23. Moon eclipsed, partly visible at Greenwich.
14h. 33m. First contact with penumbra.
15h. 47m. ,, ,, shadow.
15h. 57m. Moon sets at Greenwich.

THE TOTAL SOLAR ECLIPSE OF MAY 8, 1910.—This eclipse, which can be observed from Tasmania, is not a very favourable one, because the sun at the critical time is only about 8° above the horizon. Mr. Frank McClean, however, who has made considerable preparations for observing it, is already in Tasmania, and has collected a party of eight observers to help him utilise the numerous instruments he has taken out with him. The point he has settled upon as his observing station is situated in the south-west part of the island, namely, Hixson Point, Bramble Cove, Davey. In a cable to Dr. Lockyer, dated April 19, 11.55 a.m., he states:—"Sunday extensive scrub fire within four feet instrument tent. No damage." While on the occasion of his successful expedition to Flint Island in 1908 his chief enemy was "water," he has now had to combat "fire." Little is known at present about the site, but in a letter to the recipient of the cable he writes that one of his party "is as strong as a horse," and will be exceedingly useful "when we have to clear the 200-feet high trees out of the way and carry the packing cases up a 600-feet hill." It will thus be seen that he is making every endeavour to secure as good a site as possible, and it is hoped that his energy will be rewarded with success.

HALLEY'S COMET.—Reports from a number of places state that Halley's comet has been seen as a fairly bright object, under favourable conditions, with the naked eye. Cloudy weather has seriously interfered with English observers, but the comet was seen, and estimated to be of the second magnitude, at Greenwich on the morning of April 25, and was followed until nearly sunrise. According to the *Times* report, it was probably seen with the naked eye, and photographs were secured with several instruments. Owing to the brightness of the sky, exposures of one minute only were possible, and the resulting plates show only the nucleus and coma, with no reference stars. The appearance of the comet was that of a small whitish cloud with a brighter nucleus. The *Times* also states that good positions of the comet were secured by Dr. Ristenpart, at Santiago, on April 12, 15, and 21, and that he has re-determined the time of perihelion passage as April 19·6803 (G.M.T.), about an hour later than was determined by Mr. Merfield. Observations by Mr. Ryves at Saragossa, Spain, on April 21, showed, from naked-eye comparisons with γ Pegasi, that the magnitude was about 2·7. Mr. Innes also reports a naked-eye observation at Lyme Regis on April 25, between 4h. and 4h. 30m. a.m. Similar observations are reported from Malta and Gibraltar, and, at the former, a tail about 1° in length, and inclined about 40° to the horizon, was seen.

In No. 16 of the *Comptes rendus* (p. 955, April 18) M. Giacobini reports having observed the comet, at the Paris Observatory, between 16h. and 18h. on April 17. He was surprised at the increase in brightness since March 7, when the magnitude was estimated as 9·5; at present he estimates it as 2·0 or 2·5. Taking the ephemeris values for the distances from the sun and earth, this means that on May 18, 19, and 20 the magnitude should be $-1·3$ to $-1·8$, as bright as, or brighter than, Sirius. To M. Giacobini the comet appeared as a circular nebulosity 30″ to 35″ in diameter, with a strong central con-

densation. No tail was distinguished except a small swelling of the circular nebulosity in position-angle 350°, but this measured scarcely one minute of arc in length.

Those observers who are generally unacquainted with celestial objects should note that Venus, as shown in Fig. 1 on p. 224 in last week's NATURE, is a conspicuous object near the comet's position at present; we have heard of a number of enthusiastic would-be observers who have evidently mistaken this planet for the comet, as many did in the case of comet 1910*a* in January last. Referring to Fig. 2, given last week, it should be noted that the position of Mars was inadvertently omitted from the diagram. On May 22 the comet will pass directly beneath Mars, which should be inserted about half-way between the top of the date (22) and the disc representing β Geminorum.

Mr. Denning writes:—"The meteors supposed to be connected with Halley's comet are due on the mornings of May 4–7, as the earth reaches her nearest relative position to the cometary orbit at that period. This meteoric shower is directed from the immediate region of the equator in about right ascension 338°, and was discovered by Colonel Tupman in 1870, and seen also in the following year. The radiant rises late on the night, so that the meteors can only be seen in the morning twilight. It is doubtful whether or not this meteoric shower is really connected with the celebrated comet of Halley, for the distance of the earth from the comet's orbit at its nearest approach is about 6,000,000 miles, but the computed orbits of the meteors and comet exhibit a significant resemblance. Should any rich display of meteors be presented at the period mentioned, the spectacle will be unique, for the parent comet will be visible at the same time."

COMET 1910*a*.—Observations by M. Pechüle on April 8 gave corrections of +3s. and +0·6′ to the ephemeris published by Dr. Kobold in No. 4393 of the *Astronomische Nachrichten*, and showed the magnitude of comet 1910*a* to be about 11·0. In No. 4404 of the same journal Herr Tscherny discusses the difficulties attending the calculation of the orbit of this comet, and gives three sets of parabolic elements, which he compares with ten other sets previously published by various calculators.

In No. 2 (1910) of the *Bull. de l'Acad. roy. de Belgique* Prof. Stroobant publishes an account of his observations of this comet, and shows that on January 31, at 6h. 20m., the tail extended to the middle of the Great Square of Pegasus, its length being about 36°.

OPENING OF THE NEW SCHOOL OF AGRICULTURE, CAMBRIDGE.

IN the presence of an assembly fully representative of agricultural interests, both scientific and practical, the new School of Agriculture at Cambridge was opened by the Duke of Devonshire on Tuesday, April 26.

The formal opening was preceded by a luncheon party given at Pembroke College Lodge by the Vice-Chancellor. In addition to the Duke of Devonshire, the heads of colleges, and the principal professors, the guests included the Master of the Drapers' Company, Lord Blyth, Sir George Fordham, Sir C. Dalton, Sir Thomas Elliott, Sir Richard Cooper, Prof. Somerville, Mr. A. D. Hall, and Mr. T. H. Middleton. Speeches were delivered by the Vice-Chancellor, the Duke of Devonshire, the Master of the Drapers' Company, and Prof. Wood.

In declaring the building open, the Duke of Devonshire emphasised the necessity for a close alliance between the scientific and the practical aspects in agricultural work, and promised to exert his influence with the Royal Agricultural Society to further that end. He also expressed the gratitude felt by all workers in the practical field to the University authorities for the extended facilities which it now gives to students of the agricultural sciences.

The new school is situated close to the Botany School. It was erected after the designs of Mr. Arnold Mitchell at a cost of 20,000*l*. The building consists of three floors, a basement, and attics. It contains three lecture rooms, two large elementary laboratories for chemistry and botany respectively, seven smaller rooms for private research, as well as a library and private rooms for the teaching staff. The accommodation is designed for one hundred students, and is already barely sufficient for the increased numbers coming forward.

Among the exhibits on view on Tuesday, the one which appealed most to practical men was a series illustrating the work of Profs. Wood and Biffen in connection with the improvement of English wheat. Prof. Punnett showed a number of interesting experiments illustrating Mendelian principles in connection with the inheritance of colour in poultry and rabbits. The forestry exhibits of Messrs. Henry and Burdon were also of extreme interest. Mr. Foreman showed the results of a laborious research on the constitution of the proteids found in linseed.

INTERNATIONAL CONGRESSES ON ORNITHOLOGY AND TROPICAL AGRICULTURE.

WE have received the announcement that the fifth International Ornithological Congress will meet in Berlin from May 30 to June 4 inclusive. Its success seems already ensured by the large number of distinguished ornithologists (representing twenty-three countries) who have intimated their intention of attending. According to the programme, the congress will assemble in the "Festsaal" of the Zoological Gardens, and its sectional meetings will be held in the Landwehroffizier-Kasino, close to the Zoological Gardens station of the State railway, where also will be installed on May 29 and following days the business bureau. The president designate is the distinguished professor of the Berlin Natural History Museum, Dr. Anton Reichenow, the subject of whose opening address is "Uber die Fortschritte und den gegenwärtigen Stand der Ornithologie." In the ordinary course he would have been introduced by the retiring president, the late Dr. Bowdler Sharpe, and the absence of this genial personality, so familiar at these triennial congresses, cannot but cast a shadow over the meeting. The congress is divided into practically the same sections as at its last meeting:—systematic ornithology, anatomy, palæontology, geographical distribution; migration; biology and oology; bird protection; aviculture and acclimatisation; and economic ornithology. Many important papers are already announced by, among others, the president, Count v. Berlepsch, Herr Csörgey, Dr. Eckstein, Dr. Hartert, Dr. Helms, Herr Nehrkorn, Prof. Neumann, Hon. Walter Rothschild, Dr. Thienemann, and Prof. Virchow. Visits to the following places of interest have been arranged:—on Monday afternoon to the Havelsee, at the invitation of the German Ornithological Society; on Thursday morning to the Zoological Gardens, with lunch to follow; on Friday to the Natural History Museum, or a motor trip round Berlin for those who prefer it. On the evening of Tuesday there will be a kinematograph exhibition of bird pictures at the "Urania" Society's rooms. On Wednesday evening the city will entertain the members and their wives, and on Friday evening the customary banquet will take place in the Zoological Gardens. After the close of the congress excursions will be arranged, if sufficient members apply, to the observation station at Rossitten and to the experimental protection station at Seebach. The subscription for full membership is 20 marks, and for lady associates who do not desire the publications 10 marks. The secretary's address is 43 Invalidenstrasse, Berlin N. 4.

In order to facilitate the study of the problems of tropical agriculture, an International Association of Colonial Agriculture was founded in 1905 at the close of the first International Congress of Tropical Agriculture, held in Paris in that year. The association has arranged to hold a second International Congress at Brussels on May 20–23. A British committee has been formed to arrange for the contribution of papers by those concerned in tropical agriculture and colonial development. The president of this committee is Prof. W. R. Dunstan, F.R.S., and the secretary Dr. T. A. Henry, Scientific and Technical Department, Imperial Institute, S.W. As evidence of the interest taken in the work of the congress, it may be mentioned that the following papers have been promised already to the British committee:—W. L. Balls, (1) the application of Mendel's law to cotton breeding,

(2) some causes affecting the Egyptian cotton crop; G. C. Dudgeon, the cottons in indigenous cultivation in British West Africa; A. E. Humphries, wheat production in relation to the requirements of the United Kingdom; F. B. Guthrie, (1) work done in New South Wales in connection with the improvement and testing of wheats, (2) the work of the late W. J. Farrer on the improvement of wheat in New South Wales; I. B. Pole-Evans, problems connected with maize-growing in South Africa; J. B. Carruthers, (1) new methods of tapping Castilloa, (2) cover plants, as a substitute for weeding in rubber, cacao, and other cultivations; Dr. T. A. Henry and Dr. S. J. M. Auld, the burning quality of tobacco; G. M. Odlum, tobacco culture in South Africa; Mr. Easterby, cultivation and varieties of sugar-cane at the Sugar-cane Experiment Station, Mackay, Queensland; Prof. P. Carmody, (1) preparation of rubber, (2) preparation of paper from megass, (3) methods of manuring, suitable for natives, (4) influence of malarial diseases on labour supply, (5) breeding of stock suitable for the tropics; Mr. Benson, manuring of tropical fruits; Dr. S. S. Pickles, the aromatic grass oils; R. N. Lyne, causes contributing to the success of the Zanzibar clove industry; W. Macdonald, dry-farming and land settlement in South Africa; J. H. Barnes, the alkali lands of northern India; E. M. Jarvis, economic zoology in African colonies; W. Gill, the introduction of the remarkable pine (*Pinus insignis*) into South Australia, and its successful utilisation; F. W. Barwick, African wild silks; G. C. Dudgeon, some important insect pests in British West Africa; C. C. Gowdey, insects of economic importance in Uganda. The International Association of Colonial Agriculture has also arranged for the collection, in tropical countries, of information on a number of subjects of special interest, and general reports on these will be presented to the congress, as well as reports by experts in each country concerned. The inquiries already arranged for are on cotton cultivation, labour conditions in the colonies and tropical countries, acclimatisation of European cattle in tropical countries, and alcoholism in the tropics. All communications regarding the congress should be sent to the secretary of the British committee, Imperial Institute, London, S.W. Applications and subscriptions for membership should be sent to M. Vandervaeren, treasurer of the Belgian committee, at the Ministry of the Interior and of Agriculture, Brussels, Belgium.

ECONOMIC GEOLOGY IN CANADA.[1]

THE pamphlets mentioned below have been issued recently by the Department of Mines of Canada, mainly with the object of directing attention to the importance of the economic mineral products of the Dominion, and of assisting with trustworthy information those persons who are actually engaged, or may contemplate engaging, in the exploitation of its mineral wealth.

The first work on the list gives a concise but clear description of the general geological features of Canada and of the known valuable minerals that characterise the different areas. For the sake of convenience, the whole of the Dominion is divided into a number of regions, each of which has a more or less definite individual geological structure, and which accordingly produces a distinct series of economic minerals. The scope of the work is perhaps most readily explained by giving a list of the different regions into which the Dominion is here divided, these being as follows:—

(1) The Appalachian region, comprising the Maritime Provinces and that portion of the Province of Quebec which lies immediately to the north of them, consisting mainly of crystalline and Palæozoic rocks, the chief mineral products being coal, gold, and iron ores.

(2) The Lowlands of the St. Lawrence Valley, which consist mainly of Palæozoic strata, and have not, so far, shown any great mineralogical wealth, with the exception of petroleum; the principal Canadian oilfields, lying in the tongue of south-western Ontario that projects between Lakes Huron and Erie, occur in strata of Devonian age, which form a portion of this region.

(3) The Laurentian plateau, which comprises the greater portion of the Province of Ontario and of the North-western Territory; it consists mostly of pre-Cambrian—largely Laurentian—rocks, and though little more than the southern border of this vast track has been prospected, it is known to contain many valuable mineral products, such as the Sudbury copper-nickel deposits, the Cobalt silver deposits, gold, iron ores, corundum, apatite, mica, &c.

(4) The Arctic archipelago, which forms an imperfectly known area to the north of Hudson's Bay; it appears to consist mainly of pre-Cambrian and some Palæozoic strata, and so far is not known to contain minerals of any great economic importance.

(5) The Interior Continental plain, which comprises the western portion of Manitoba and the southern portion of Saskatchewan and Alberta, extending westwards to the Cordilleran mountain system, the strata being largely of Cretaceous age. The rocks contain very important beds of coal and lignite, also bitumen, indications of petroleum, and natural gas.

(6) The Cordilleran belt, which comprises the western portion of the Dominion. This is essentially a mountain region, showing a great variety of geological formations; it is noted for occurrences of the precious metals, gold and silver, whilst lead, copper, and zinc also occur; it is also very rich in coalfields, notably in British Columbia, where all varieties of coal from lignite to anthracite appear to occur.

This brief summary of a summary will serve to indicate the arrangement, the scope, and the objects of this little treatise; it should also be added that it is accompanied by two maps, one showing the broad geological features, and the other the distribution of the chief mineral products; the former is very satisfactory, but the latter is by no means so clear as might be desired. The maps serve, however, perfectly well their purpose of elucidating the text and of making the whole subject clear and readily comprehensible. Minute accuracy of detail is not to be expected in such a work as this, and is perhaps not even desirable, so that anything of the nature of criticism would be entirely out of place. It can only be said that the treatise admirably fulfils its objects, and should be of the greatest value to all who are in any way interested in the mineral wealth of the Dominion. The Geological Survey of Canada can only be congratulated upon the felicitous idea of publishing such a pamphlet and upon the excellent way in which that idea has been carried into execution.

In the second pamphlet of the above list Mr. D. B. Dowling has given an account of the coalfields of the Interior Continental Plateau, and is thus able to discuss more in detail than was possible in the general work the nature and mode of occurrence of these important deposits. The author commences with a historical and general review of the coalfields, and then describes them in some little detail. He points out that the coal of this region occurs at three main geological horizons, namely, at the base, about the middle, and close to the top of the Cretaceous formation; it should be noted that he ventures, on what can only be described as imperfect data, to attempt an estimate of the quantity of coal that exists in the region under discussion, which he gives as 143,490 millions of tons, the area of the coalfields being taken as 22,506 square miles. That the amount of development work yet done in these fields is of the scantiest possible description is evident from the fact that the output for the year 1907 was only 876,731 tons. After a detailed description of the coalfields, a large number of analyses of the various coals is tabulated. This list is an exceedingly useful one, and the author has done excellent service in collecting the records into a conveniently accessible form. Following this list is another of analyses of coals from other districts, apparently for the purposes of comparison: it is, however, not at all clear on what principle he has brought together this miscellaneous collection of analyses of coals from British Columbia, Yukon, Nova Scotia, Wales,

[1] Canada Department of Mines. (1) "A Descriptive Sketch of the Geology and Economic Minerals of Canada." By G. A. Young, with an introduction by R. W. Brock. Pp. 151.
(2) "The Coal Fields of Manitoba, Saskatchewan, Alberta, and Eastern British Columbia." By D. B. Dowling. Pp. 111.
(3) "The Whitehorse Copper Belt, Yukon Territory." By R. G. McConnell. Pp. 63.
(4) "Report on the Iron Ore Deposits along the Ottawa (Quebec Side) and Gatineau Rivers." By Fritz Cirkel. Pp. 147.

Australasia, and the United States, still less why the whole of the coals of Great Britain should be considered to be adequately represented by analyses of some half a dozen Welsh coals. Such a comparative list should either be truly representative or else (and perhaps better) be omitted altogether. There appears to be no obvious reason why Mr. Dowling should want any new-fangled mode of classification in order to enable him satisfactorily to classify these coals. For most practical purposes the old classification of Gruner answers perfectly well, and if anything more precise is required, the fuel ratio (or the ratio of the fixed carbon to the volatile combustible matter) suffices for most purposes. The ratio suggested by the author, which he calls the "split volatile" ratio, appears to serve no particular purpose, and, on the other hand, would enable a coal to be put into almost any class at will by merely drying it more or less thoroughly before analysing it.

The two remaining treatises deal in more or less detail with ore deposits in definite regions, differing mainly in this respect that the copper deposits of the Whitehorse Belt have been opened up pretty extensively and are being actively worked to-day, whilst the iron ores of the Ottawa and Gatineau Rivers are not to-day of any economic importance.

The last treatise on the list is in some respects the least satisfactory. So long as the writer keeps to his proper subject, namely, a description of the ore deposits, their modes of occurrence, distribution and geology, there is little fault to be found, although the language is in places somewhat less clear than might be wished. It is, however, when the author ventures into metallurgical discussion that he seems to go widely astray. It is incomprehensible how anyone could write such a sentence as the following in discussing the metallurgy of iron (p. 104):—"By no known chemical or electro-thermic process can phosphorus be eliminated from the bath of any of the diverse metallurgical furnaces." The author seems to be exceedingly sanguine as to the future of the electrical production of pig-iron in the Dominion, an opinion which he seems to share with some other Canadian geologists. It is somewhat curious to note that it is the geologists who are urging on this metallurgical development, whilst manufacturers of iron appear to be more than doubtful as to its economic possibilities. Whether this is due to the well-recognised conservatism of the latter and the advanced scientific enterprise of the former, or whether it is a case of geologists rushing in where iron-masters fear to tread, is not for us to determine. HENRY LOUIS.

RECENT PAPERS ON BIRDS.

MR. C. W. BEEBE is to be congratulated on his attempt (*Zoologica*, No. 5) to explain the "racket-making" habit of the motmots. These birds, it is almost unnecessary to mention, are in the habit of removing the vanes of the middle pair of elongated tail-feathers for a certain distance, so as to give them a racket-like form very similar to that which occurs naturally in certain kingfishers and humming-birds. It is shown that the length of feather thus devaned is invariably constant, even when the adjacent pair of feathers, which might serve as a guide, has been removed. Further, the portion destined to be stripped has the vanes markedly narrower than in the rest of the feather, while the component barbs and barbules are much weaker and less coherent than elsewhere, so that their removal is a comparatively easy matter. Consequently, in the course of the preening to which these birds subject all their tail-feathers, the weak area in the vanes of the middle pair becomes stripped, with the production of the symmetrical pair of terminal rackets. The original cause of the narrowing and degeneration in the affected area is still unknown, but the author is of opinion that it is not a case of the inheritance of an acquired character.

In No. 2 of the same serial Mr. Beebe gives the results of his observations on the habits of that remarkable bird the hoazin, or hoatzin (*Opisthocomus cristatus*), made during a visit in March, 1908, to Venezuela, and a second in April of the following year to British Guiana. As young birds were not to be found, the notes relate only to the adult. Mr. Beebe commences his account by mentioning that the crop of the hoazin is unique on account of having assumed the structure and function of the gizzard of other birds, being much larger than ordinary, with the walls thick and muscular instead of thin and flabby. Despite this specialised feature, the primitive character of this bird is indicated by many points, the vestigial claw of the third digit of the wing linking it with Archæopteryx, while another claim to primitiveness is apparent in the quadrupedal habits of the young. Thickly wooded river-valleys form the haunts of the hoazin, of which Lower Amazonia may be considered the centre, the distributional area, according to our present information, being in several instances discontinuous. The bird has a peculiarly disagreeable odour of its own, which is, however, in Mr. Beebe's opinion, less powerful than commonly reputed, and, at all events, insufficient to render it immune to the attacks of parasites. In general character the nest and eggs are very similar to those of the Guiana green herons (Butorides), but are placed higher above the water. Both sexes assist in nest-building, and two eggs seem to be the usual number in a clutch. There is no foundation for the assertion that these birds are polygamous, or, of course, for the old legend as to their snake-eating habits.

The institution and celebration of the first "bird-day" in the Australian Commonwealth is recorded in the January number of the *Emu*. October 29, 1909, was the date selected in Victoria, when the celebration proved a thorough success, parents, teachers, and scholars joining in with enthusiasm, and visits being paid to noted bird-haunts in the different districts. Numerous nests were examined, but in no instance were either birds or eggs molested. A certain amount of preliminary work had to be done in teaching the children the names of many of the local birds, for which purpose special lists were prepared. In the same issue Mr. C. Barrett describes the nesting of the rock-parrakeet (*Neophema petrophila*) on Goat Island, Kellidic Bay. Here this appropriately named species rears its young in hundreds, the eggs being often laid deep down in burrows, although higher up on the cliffs they are frequently placed on the bare rock, in most cases under the protection of a raised stone.

In the March number of the *Zoologist* Mr. J. M. Dewar describes the manner in which the oyster-catcher breaks the shell of the purple whelk (*Purpura lapillus*) in order to be able to feed on its contents. As the soft-parts of this mollusc are much more difficult of access than those of mussels and limpets, the bird only occasionally attacks the whelk, and perhaps never does so at all in some localities. When a mollusc is to be operated upon, it is carried to some convenient spot, often a crack or hollow in the rock, or it may be a hard patch of sand, where it is laid with the mouth uppermost. The upper half of the beak is then introduced into the aperture, and an attempt made to punch out a small fragment from the opposite surface of the shell. If this is successfully accomplished, and the piece punched out is of small size, the beak is introduced into the new aperture, and the same process repeated higher up the shell, when, if it succeeds, the soft-parts can be scooped out. In cases where the first hole is larger, the latter operation can be accomplished by that aperture. Frequently the shell defies the bird's efforts.

The January number of the *Victorian Naturalist* contains the report of a paper, by Mr. A. H. E. Mattingley, on the breeding-habits of Australian cuckoos, in which it is stated that only an infinitesimal proportion of their eggs approximate in size, colour, markings, and shape to those among which they are laid. There are, moreover, numerous instances in which Australian cuckoos have laid in the nests of graminivorous birds, with the consequent starvation of the young. In other instances cuckoos lay in nests already containing eggs of their own species, while they also make use of nests too small to contain the young bird in comfort. It is concluded that, so far at least as Australian species are concerned, cuckoos, in place of possessing an instinct leading to the selection of suitable foster-parents, lay their eggs haphazard.

Ever since the year 1904 Dr. F. A. Forel has been endeavouring to ascertain the approximate number of individuals of the black-headed gull (*Larus ridibundus*) which resort to Lake Leman during certain months of the year, and likewise to explain the reason why many

these birds are to be seen on the lake at seasons when ie majority of their kindred are in far distant lands. hese observations and their results have been published the *Bulletin de la Société Vandoise des Sci. Nat.* for 905 and 1910. The gulls are most numerous from the id of July to the middle of October—during which period ieir numbers may reach as many as 3600—but the great ulk disappears during the breeding-season, and again in inter. For their breeding resorts in the north the birds ke their departure towards the end of March, although few hundreds remain on the Haut Lac throughout the ason. Of these stay-at-home individuals only a small ercentage nest on the lake, and it seems probable that ie great majority are aged birds the breeding-days of hich are over. On the other hand, a certain number of igrating gulls reappear on the lake at the beginning of uly, several weeks before their fellows. Several explana-ons of this have been given, but it seems, on the whole, iost probable that these early arrivals are birds which ave completed their parental duties in the north at an nusually early date. It is well known that dark barrings n the tail are a sign of immaturity in this species, which enerally disappear when the birds are about eighteen ionths old; on the other hand, the dark cap on the head not assumed until the third year, while the birds do not y until they are twenty-three months old. A certain umber of birds are, however, met with in their second ummer with the tail barred and the head dark, and these iust probably be regarded as precocious individuals. inally, the author has succeeded in demonstrating that he black-headed gull is not a diver.

The Land Agents' Society some time ago commissioned Ir. Walter E. Collinge to institute an inquiry into the eeding-habits of rooks, the results of which have been ublished in pamphlet form by Messrs. Laughton and Co., td., Wellington Street, Strand. Observations made on nore than 800 specimens from various parts of England ndicate that (1) 67·5 per cent. of the food of these birds onsists of grain, this, by the inclusion of roots and fruits, eing raised to 71 per cent.; (2) the animal-food is 29 per ent., of which fully one-third is to be reckoned against he utility of the rook; (3) a grain-diet is certainly pre-ferred; (4) the rook is not a particularly beneficial bird to he agriculturist, although its utility might be increased f its numbers were diminished.

In connection with the above, reference may be made to paper by Dr. J. E. H. Kelso in the April number of he *Zoologist*, where it is shown that, in addition to doing onsiderable damage to fruit, the starling is nowadays an nemy to the farmer by devouring considerable quantities of wheat, such grain being presumably devoured for its wn sake, and not on account of containing grubs. This wheat-eating propensity is considered to be a modern levelopment.

In the same issue Mr. E. J. Stubbs makes out a strong laim, not only that the white egret (*Ardea garzetta*) should be added to the British list, but likewise that in he Middle Ages it was a common species in our islands. From various old works the author quotes passages ndicating that a small white heron-like bird, without a rest, was commonly put on the table at state banquets n the north of England, where it was taken in the eighbouring marshes, and that this bird could have been iothing else than the egret, by which name it is indeed nentioned. The idea that the lapwing could have been ntended is shown to be altogether untenable, and, indeed, he author adduces evidence to show that the present ibundance of the latter bird is a modern feature.

LANGLEY'S CONTRIBUTIONS TO AERONAUTICS.[1]

THE award of the Langley medal to the Brothers Wilbur and Orville Wright emphasises the fact that we are iving in an age of great achievements. The twentieth entury had hardly dawned when the world was startled by the discovery of radium, which has opened up an ntirely new field to science, and has led us to modify profoundly our conceptions regarding the constitution of matter. Another new field has been revealed to us through the development of wireless telegraphy and telephony, and we now utilise the vibrations of the ætherial medium of space for the transmission of thought.

Then, again, we may note the most revolutionary changes going on before our eyes relating to methods of transportation. The appearance of the hydroplane-boat probably foreshadows a revolution in marine architecture and propulsion. On land we see motor-cycles, automobiles, and electric cars displacing the horse. Petroleum and electricity have become powerful rivals of steam, and we seem to be on the eve of a revolution in our methods of railroad transportation through the application of the gyroscope to a mono-rail system; and now aërial transport has come, dispensing with rails and roads altogether. The air itself has become a highway, and dirigible balloons and flying machines are now realities.

How well the predictions of Langley have been fulfilled. We now recognise that he was right when he said, a few years ago (1897), that:—"The world, indeed, will be supine if it do not realise that a new possibility has come to it, and that the great universal highway overhead is now soon to be opened."

It has been opened; and who can foretell the consequences to man? One thing is certain, that the physical obstacles to travel have been overcome, and that there is no place on the surface of the globe that is inaccessible to civilised man through the air. Does this not point to the spread of civilisation all over the world, and the bringing of light to the dark continents of the earth?

The Pioneers of Aërial Flight.

Who are responsible for the great developments in aërodromics of the last few years? Not simply the men of the present, but also the men of the past.

To one man especially is honour due, our own Dr. S. P. Langley, late secretary of the Smithsonian Institution. When we trace backwards the course of history we come unfailingly to him as the great pioneer of aërial flight. We have honoured his name by the establishment of the Langley medal; and it may not be out of place on this, the first occasion of the presentation of the medal, to say a few words concerning Langley's work.

Langley's Work.

Langley devoted his attention to aërodromics at a time when the idea of a flying machine was a subject for ridicule and scorn. It was as much as a man's reputation was worth to be known to be at work upon the subject. He bravely faced the issue, and gave to the world his celebrated memoir entitled "Experiments in Aërodynamics." In this work he laid the foundations for a science and art of aërodromics, and raised the whole subject of aërial flight to a scientific plane.

The knowledge that this eminent man of science believed in the practicability of human flight gave a great stimulus to the activities of others, and started the modern movement in favour of aviation that is such a marked feature of to-day.

Everyone now recognises the influence exerted by Langley on the development of this art. The Wright Brothers, too, have laid their tribute at his feet.

"The knowledge," they say, "that the head of the most prominent scientific institution of America believed in the possibility of human flight was one of the influences that led us to undertake the preliminary investigations that preceded our active work. He recommended to us the books which enabled us to form sane ideas at the outset. It was a helping hand at a critical time, and we shall always be grateful."

Contributions to the Science of Aërodromics.

Langley's experiments in aërodynamics gave to physicists, perhaps for the first time, firm ground on which to stand as to the long-disputed questions of air resistances and reactions. Chanute says:—

(*a*) They established a more trustworthy coefficient for rectangular pressures than that of Smeaton.

(*b*) They proved that upon inclined planes the air pressures were really normal to the surface.

[1] Address delivered by Dr. Alexander Graham Bell at the presentation of he Langley medal of the Smithsonian Institution to the Wright Brothers n February 10.

(c) They disproved the "Newtonian law," that the normal pressure varied as the square of the angle of incidence on inclined planes.

(d) They showed that the empirical formula of Duchemin, proposed in 1836 and ignored for fifty years, was approximately correct.

(e) That the position of the centre of pressure varied with the angle of inclination, and that on planes its movements approximately followed the law formulated by Joessel.

(f) That oblong planes, presented with their longest dimension to the line of motion, were more effective for support than when presented with their narrower side.

(g) That planes might be superposed without loss of supporting power if spaced apart certain distances which varied with the speed; and

(h) That thin planes consumed less power for support at high speeds than at low speeds.

The paradoxical result obtained by Langley, that it takes less power to support a plane at high speed than at low, opens up enormous possibilities for the aërodrome of the future. It results, as Chanute has pointed out, from the fact that the higher the speed the less need be the angle of inclination to sustain a given weight, and the less, therefore, the horizontal component of the air pressure.

It is true only, however, of the plane itself, and not of the struts and framework that go to make up the rest of a flying machine. In order, therefore, to take full advantage of Langley's law, those portions of the machine that offer head resistance alone, without contributing anything to the support of the machine in the air, should be reduced to a minimum.

Contributions to the Art of Aërodromics.

After laying the foundations of a science of aërodromics Langley proceeded to reduce his theories to practice. Between 1891 and 1895 he built four aërodrome models, one driven by carbonic acid gas and three by steam engines. On May 6, 1896, his *Aërodrome No.* 5 was tried upon the Potomac River, near Quantico. I was myself a witness of this celebrated experiment, and secured photographs of the machine in the air, which have been widely published. This aërodrome carried a steam engine, and has a spread of wing of from 12 to 14 feet. It was shot into the air from the top of a house-boat anchored in a quiet bay near Quantico. It made a beautiful flight of about 3000 feet, considerably more than half a mile. It was indeed a most inspiring spectacle to see a steam engine in the air flying with wings like a bird. The equilibrium seemed to be perfect, although no man was on board to control and guide the machine.

I witnessed two flights of this aërodrome on the same day, and came to the conclusion that the possibility of aërial flight by heavier-than-air machines had been fully demonstrated. The world took the same view, and the progress of practical aërodromics was immensely stimulated by the experiments.

Langley afterwards constructed a number of other aërodrome models, which were flown with equal success, and he then felt that he had brought his researches to a conclusion, and desired to leave to others the task of bringing the experiments to the man-carrying stage.

Later, however, encouraged by the appreciation of the War Department, which recognised in the Langley aërodrome a possible new engine of war, and stimulated by an appropriation of 50,000 dollars, he constructed a full-sized aërodrome to carry a man. Two attempts were made, with Mr. Charles Manley on board as aviator, to shoot the machine into the air from the top of a house-boat, but on each occasion the machine caught on the launching ways and was precipitated into the water. The public, not knowing the nature of the defect which prevented the aërodrome from taking the air, received the impression that the machine itself was a failure and could not fly.

This conclusion was not warranted by the facts; and to me, and to others who have examined the apparatus, it seems to be a perfectly good flying machine, excellently constructed, and the fruit of years of labour. It was simply never launched into the air, and so has never had the opportunity of showing what it could do. Who can say what a third trial might have demonstrated? The general ridicule, however, with which the first two failures were received prevented any further appropriation of money to give it another trial.

Conclusion.

Langley never recovered from his disappointment. He was humiliated by the ridicule with which his efforts had been received, and had, shortly afterwards, a stroke of paralysis. Within a few months a second stroke came, and deprived him of life. He had some consolation, however, at the end. Upon his death-bed he received the resolution of the newly formed Aëro Club of America, conveying the sympathy of the members and their high appreciation of his work.

Langley's faith never wavered, but he never saw a man-carrying aërodrome in the air. His greatest achievements in practical aërodromics consisted in the successful construction of power-driven models which actually flew. With their construction he thought that he had finished his work, and in 1901, in announcing the supposed conclusion of his labours, he said:—

"I have brought to a close the portion of the work which seemed to be specially mine—the demonstration of the practicability of mechanical flight—and for the next stage, which is the commercial and practical development of the idea, it is probable that the world may look to others."

He was right, and the others have appeared. The aërodrome has reached the commercial and practical stage, and chief among those who are developing this field are the Brothers Wilbur and Orville Wright. They are eminently deserving of the highest honour from us for their great achievements.

I wish to express my admiration for their work, and believe that they have justly merited the award of the Langley medal by their magnificent demonstrations of mechanical flight.

INDUSTRIAL ENGLAND IN THE MIDDLE OF THE EIGHTEENTH CENTURY.

THE conditions of the chief industries of the country at the date (1754) when the Society of Arts was founded were surveyed by Sir Henry Trueman Wood in an elaborate paper read by him at a meeting of the society on April 20. In the middle of the eighteenth century England was not to any noteworthy extent a manufacturing country, the most important industry being agriculture and occupations relating to it. At the epoch to which the paper refers, however, an industrial revolution was beginning which transformed England from an agricultural country, with no manufactures beyond those required for the supply of its own population, into the workshop of the world. Sir H. T. Wood described the positions of industries concerned with wool, cotton, linen, silk, various metals, brewing, distilling, tanning, paper, printing, and many other arts. From the mass of historical material brought together in the paper a few extracts are subjoined upon subjects associated with science. The retrospective view which these extracts provide is of interest to students of the progress of science and industry.

Science.

Science, about the middle of the eighteenth century, was not in a condition of active progress either in England or abroad. The time was not, either for science or scientific men, a happy one. International intercourse was impeded by wars; national progress was hindered by political differences. The great days of Newton, Hooke, Boyle, and Halley were past. Those of the founders of modern science were yet to come. Cavendish had just left Peterhouse. Priestley had not yet turned his attention to natural philosophy—his scentific work began in 1758. Banks, who ruled the Royal Society for so many years, was in 1754 a boy of eleven. Gilbert White (b. 1720) commenced his "Garden Kalendar" in 1751, but he did not make Pennant's acquaintance until thirteen years later, when he started the famous correspondence which formed the groundwork of the immortal "Natural History of Selborne." Franklin had completed and made public his

epoch-making experiments, and (in 1752) proposed to protect buildings by the lightning-rod. Black, the friend of Watt, and the enunciator of the principle of "latent heat," produced his first important work as a thesis for his M.D. degree in 1754.

In the earlier part of the century the power of mathematics in enabling us to grapple with the most abstruse problems of nature was first clearly demonstrated. In the latter part the foundations were laid on which the modern science of chemistry was built. The intervening years were not characterised by any marked progress in abstract science.

The Royal Society (to which a charter had been granted in 1662) was now firmly established at the head of British Science. Though it was still deemed a suitable object for the occasional shafts of humorists, and though it was sometimes attacked by quacks whose pretensions it declined to countenance, it was recognised and respected by all serious students of science at home and abroad. It had gathered to itself the best thought of the country, and was affording to what would otherwise have been the isolated efforts of scientific pioneers the advantage of coordination and cooperation.

Scientific attention was then principally, though by no means exclusively, directed to astronomy and to exploration. The transits of Venus of 1761 and 1769 had been predicted by Halley, and great importance was attached to their proper observation. An Act of 1743 offered a reward of 20,000*l.* for the discovery of a north-west passage, and later the discoveries of Captain Cook received full scientific recognition by the award of the Copley medal.

Perhaps no better indication of the state of scientific progress at any time in England could be found than is provided by the list of the Royal Society's Copley medallists. In 1731 and 1732 the medal was awarded to Stephen Gray,[1] the ingenious electrician who contrived a method of sending signals by means of frictional electricity, and who made, therefore, the first electric telegraph. It must, however, be added that the award seems to have been rather in the nature of acknowledgment of a skilful experiment than of appreciation of an important discovery. Bradley received the medal in 1748 for his discovery of the aberration of light, and Harrison in 1749 for his chronometer. In 1753 it was given to Franklin for the lightning-rod, and in 1758 to Dollond for his achromatic telescope.

The nature of these last three awards shows the tendency of the time towards practical rather than towards abstract science, and justifies the conclusion that the leaders of scientific thought of those days were working rather for practical results than for the advance of theoretical knowledge.

Iron.

The history of the origin and growth of the iron manufacture in England has been often told. The first step in its progress was the substitution of coal for wood charcoal in the process of reducing the metal from its ores. In the ironworks of Sussex and elsewhere the iron was made on open hearths, or small furnaces, by the help of bellows worked by hand or water. In early times the natural force of the wind was utilised, which, as an early writer says, "Saveth the charge of the bellowes and of a milne to make them blow."

In such furnaces, with their moderate temperatures, uncoked coal could not be used, and the sulphur and other components of the coal affected the product injuriously. Nevertheless, numerous efforts were made—more or less successfully—to use the cheaper and more abundant fuel, and but a very few years before the special date with which we are concerned, the new method may be said to have been placed on a commercial footing.

It was at Coalbrookdale,[2] in Shropshire, that Abraham Darby established the manufacture of iron by coal about 1730 or 1735. He treated the coal as the charcoal-burners treated wood, and found that in the resulting coke he had the fuel he required. In 1754 he had some seven furnaces (presumably small blast furnaces or reverberatory furnaces), and for blowing these he had five "fire engines" (steam or atmospheric engines), which pumped water to drive water-wheels which worked the bellows, the "rotative" engine not having then been invented. Such was the point that the manufacture of iron had reached at the time about which we are concerned. A few years later, in, or shortly after, 1760, Dr. Roebuck used blowing engines at the Carron Iron Works in Stirlingshire. These had four single-acting cylinders of cast-iron 4 feet 6 inches in diameter, and the pistons, of which the stroke was 4 feet 6 inches, were worked in alternation, so that a continuous and tolerably equal blast was maintained.[1] They were constructed by Smeaton.

It was the father of this Abraham Darby, Abraham the elder, who introduced into England about 1706 the art of casting iron vessels. The story, old and well known as it is, will bear re-telling. Early in the century John Darby brought over some Dutch brass-founders, and set up a foundry in Bristol. Here he tried to make iron pots instead of brass, but failed, until his Welsh apprentice, John Thomas, "thought he saw how they had missed it," tried the experiment, and, working secretly with Abraham Darby (the son of John), cast the same night an iron pot. "For more than 100 years after the night in which Thomas and his master made their successful experiment of producing an iron casting in a mould of fine sand, with its two wooden frames and its air-holes, the same process was practised and kept secret at Colebrook Dale, with plugged key-holes and barred doors."

It is about this date (1740, or a little later) that Huntsman perfected the process of making cast steel, which is still employed. Before this, "Steel was never melted and cast after its production." "By whatever method prepared, whether by the addition of carbon to malleable iron, or by the partial decarbonisation of pig iron . . . steel in mass was never obtained homogeneous." There is no need to describe the process, with its purely technical details. It may be sufficient to record the fact that the problem of producing ingots of steel of uniform composition was solved by Benjamin Huntsman, and that, as his secret method of working was stolen by a workman, it soon came to be generally employed in the Sheffield steel trade.

These early founders of the great British iron trade were soon followed by many others, chief of whom was Henry Cort with his invention of puddling (1783), and the manufacture, stimulated, in the later days of the century, to meet the rapidly growing demand for iron caused by the development of machinery and the steam engine, soon reached a most important place among the industries of the country.

Copper and Brass.

Without considerable research it might be difficult to give anything like a trustworthy account of the condition of metalliferous mining and metallurgy in the middle of the eighteenth century, and even if the labour were undertaken it would be difficult to ensure accuracy of result. Copper, tin, and lead have been mined and smelted in Great Britain from very early dates. Zinc, in the metallic state, was imported from China (or, at all events, from the East) in the early part of the seventeenth century,[2] but it does not seem to have been made in England until a century later.

Percy, while he professes himself unable to give a complete history of copper-smelting in England, tells us of early copper-mines in Cumberland and Northumberland, and thinks that the ores were smelted on the spot; but copper was imported from Hungary and Sweden, while calamine (zinc carbonate) was allowed to be exported as ballast. About the end of the seventeenth and the beginning of the eighteenth century copper-smelting was being carried on in Yorkshire and Lancashire, also a little later in Cornwall, in Gloucestershire, and at Bristol. The date of the establishment of copper works at Swansea (now the centre of the trade) is given as 1720, though Percy states that smelting was carried on in the Principality before that date. Brass (an alloy of copper and zinc), as distinct from bronze (copper and tin), was known

[1] Gray it was who first proposed the theory of positive and negative electricity.

[2] This is the usual spelling. Percy has Colebrook, and gives Coldbrook as the original name.

[1] Percy, "Iron and Steel," p. 889.

[2] Percy's "Metallurgy" (1861), p. 519.

"early in the Christian era, if not before its commencement"; but this was doubtless made, like early bronze, by mixing the ores before or in the process of smelting. By the middle of the century considerable progress had been made in its manufacture. Though brass, native and imported, was known in England long before, it is believed that it was not until the reign of Elizabeth that its manufacture was seriously undertaken. From that time forward a good deal of brass seems to have been made from British ores, and a goodly number of brass articles produced.

Tin.

Tin is certainly the most ancient of British exports. It was mined in this country before Britain was known to the Romans, and was brought by the Phœnicians from Cornwall and Devon, the Cassiterides (tin-lands), far beyond the Pillars of Hercules. For centuries England had what was almost a monopoly in supplying tin to the civilised world, the amount mined in Cornwall and the west of England growing steadily both in bulk and value until the discovery by the Dutch of large supplies of tin in Banka, Sumatra, whence it was first imported into Europe about 1787.

The most important application of tin is to the coating of iron-plate, to produce what is known as tin-plate or tinned plate, and is now popularly termed tin. Until the middle of the seventeenth century this manufacture was not known in England. English tin was exported to Saxony, where it was used to coat plates, which were sent to England. That ingenious projecter and author, Yarranton, found out the German methods, and established a factory in the Forest of Dean, where plates were made better, it is said, than the German productions. It seems likely that the secret lay in rolling out the iron, previous attempts having been made with hammered plates. From this date the manufacture of tin-plate, and the use of rolls for the purpose, appears to have been established in England.

Lead.

The reduction of lead from its ores is a comparatively simple process, and it might not be untrue to say that the process has been rather developed than radically changed from the time when Pliny referred to British lead as used for the manufacture of lead pipes in Rome. Down to some time in the seventeenth century wind was relied upon for feeding the Derbyshire furnaces, which (as in Pliny's time) were placed on high ground to catch the breezes. Later, bellows driven by water-wheels were employed. Cupola furnaces were introduced into Derbyshire from Wales about 1747. These are identical with those now used. Coal was employed for smelting lead in the seventeenth century, there being two patents (1678 and 1690) granted for this privilege.

Coal.

The use of coal for fuel is referred to in a grant of land to the Abbey of Peterborough in A.D. 853. Records referring to the existence of collieries in Scotland go back as far as the end of the twelfth century, and in the thirteenth there is evidence that coal was brought to London by sea from the north. Such coal, besides being used for domestic purposes, was at first used for lime-burning, soon after in smiths' forges, and in later times for the smelting of copper and lead, in furnaces for the manufacture of pottery and glass, for drying malt, for making salt, by brewers, and for other industrial purposes.

Curiously enough, many of the earlier references to coal are due to its objectionable qualities. Its smoke and smell were disapproved of, and not without reason. In 1306 there was a Royal Proclamation against the use of coal in London, and there were many complaints about its smoke in later years. As its employment became more popular it became an article of commerce, and in 1563 an Act of Parliament prohibited its export, either in the form of ballast or otherwise. By the middle of the century it was, of course, worked on a large scale. As the shafts of the collieries grew deeper, in the effort to comply with the growing demand, fresh difficulties were encountered. The deepest shaft in 1754 appears to have been that at Whitehaven, which reached a depth of 130 fathoms (or about 800 feet), and this must have been quite exceptional, for probably hardly any coal was worked at a greater depth than 100 fathoms.[1]

Early in the eighteenth century fire-damp began to claim its victims. Its existence had been recognised long before, but very little was known about its nature. There were in the first half of the century several serious explosions with a considerable loss of life. The earliest effort to improve matters by ventilation was made about 1732, when the first attempt was made to produce a draught by means of furnaces. Between that date and 1754 considerable improvements were made in ventilation, and at that time, or a few years later, something like the modern system had been introduced by Spedding.

The great danger connected with fire-damp was, of course, the use of naked lights. From the earliest times lamps and candles were employed, and miners had got to be very expert in detecting the presence of fire-damp by the use of the latter.[2] When it was found that the use of naked lights was dangerous, attempts were made to provide a light which would not fire the inflammable gas. The best of these was the "steel mill," the date of which is probably somewhere between 1740 and 1750. This apparatus was introduced by Spedding in consequence of some experiments by Sir James Lowther, which seemed to show that fire-damp was not ignited by sparks from a flint and steel. It consisted of a steel disc rotated by hand, against which a flint was held. The result was a shower of sparks, which gave a very faint, dim light, and for long it was erroneously believed that the apparatus was not capable of firing the gas. Nothing better, however, was known until Dr. Clanny's lamp in 1812, the precursor of the safety lamps of Davy and Stephenson.

Another great difficulty—perhaps the greatest felt by the miner—was that of keeping the mines free from water. From the early part of the century Newcomen's steam, or rather atmospheric, engine had been successfully used for this purpose, all other attempts at pumping having been found quite unable to deal even with the short shafts then existing.

In the earliest coal mines the mineral had been raised to the surface by men climbing ladders, or in baskets worked by horse-gins; but the successful use of the steam engine for pumping suggested its application to haulage, and about 1753 attempts were being made to apply it to this purpose. In the earliest of these "a basket of coals was raised by the descent of a bucket of water, the steam engine being employed to re-pump the water to the surface."[3]

Later in the century the hardly less clumsy method was employed of pumping water to a height and causing it to work water-wheels, which served to wind the coal to the surface. This roundabout and costly device was coming largely into use, when the application of the crank to the steam engine enabled the necessary rotation of the winding drum to be obtained direct from the engine.

Glass.

From a very early date glass had been manufactured in many places in England, and on a considerable scale. Most of this early glass was inferior, greenish in colour, and principally used for windows, though drinking-vessels of tumbler shape were also produced of the same material.[4] At the date with which we are dealing large amounts of this same glass were being made in London, Newcastle, Birmingham, and elsewhere.

The materials employed were sand or "rock" (ground sandstone) and a crude alkali obtained from the ashes of plants. In this country the best alkali was obtained from burning kelp, and the collection and burning of that plant was a considerable industry on the coasts of Ireland and Scotland until the discoveries of Leblanc in 1792 enabled salt to be converted into carbonate of soda, and so put an end to the treatment of ashes for the potash and soda they contain. For making the commonest sort of green glass for glazing purposes the ashes of various plants were

[1] Wills' Cantor Lectures on "Explosions in Coal Mines" (1878), Journal of the Society of Arts, vol xxvi, p. 458. Galloway, "History of Coal-mining."
[2] Wills. Cantor Lecture, Journal, vol. xxvi., p. 474.
[3] Galloway, "History of Coal-mining."
[4] Hartshorne, "Old English Glasses" (1897).

employed, fern being one of the most common. The ashes of kelp were not only rich in alkali, but contained a large proportion of lime, which was a necessary ingredient.

The best alkali, known as barilla, soda of Alicante, &c., came from the East, and was produced by burning kali (hence, of course, the name of alkali) plants of the genus Salicornia, or glass wort. This Eastern alkali was certainly used in Venice, Bohemia, and France, and perhaps it may have been imported here also for the better sorts of glass. Saltpetre, either imported or obtained from accumulations of animal and vegetable refuse (nitre-heaps), was also occasionally used. The use of manganese for improving the colour of the glass was well known.

The most important feature, however, of the English glass manufacture in the middle of the century was certainly the production of what is still known as "flint" glass, and was at the time also commonly called "cristal" or "crystal." This was far whiter and more brilliant than any glass which could then be made by other methods. It was employed chiefly for making drinking-vessels, but also for mirrors. The name "flint" arose from crystal glass having originally been made from crushed flint, which provided a nearly pure form of silica. The so-called "flint" is really a lead glass. The best authorities seem to hold that the use of lead was first proposed in England some time in the seventeenth century, though neither the name of the inventor nor the precise date of the invention is known.[1]

Nesbitt thinks the glass-works established by Sir R. Mansell near Newcastle under his patent of 1614 owed their success to the use of lead, and it seems that England had for long a practical monopoly of the manufacture. Hartshorne quotes a French writer as his authority for the statement that in 1760 English flint-glass makers sent four-fifths of their output abroad, the whole of France being supplied with flint glass from England.

Watch-making.

During the eighteenth century the art of horology reached a high level in this country. Tompion, "the father of British watch-making," died in 1713, but his friend and successor, Graham, lived until 1751. Both were buried in Westminster Abbey. Graham invented the mercurial pendulum for compensating variations of temperature, and described it before the Royal Society in 1726. The lever compensation pendulum, acting by the different expansions of brass and steel, and commonly called the "gridiron pendulum," was invented by John Ellicott about 1735. In 1728 John Harrison showed his first chronometer to Arnold, who gave him the good advice that he should go back home into the country and perfect it. This he did, and in 1735 he brought it up to London again to enter it in competition for the reward offered by an Act of Parliament passed in 1714, which promised 10,000*l.* to the inventor of a chronometer capable of determining, within certain limits of accuracy, the longitude of ships at sea. The following year (1736) the Board of Longitude gave him 500*l.* after an experimental voyage, and in 1761 the chronometer was more completely tested by a voyage to Jamaica, when the Board awarded Harrison the full prize, though he did not get paid the whole of it until 1769. In 1749 he received the Royal Society's medal. Mudge (1715–94) and Arnold (1734–99) improved Harrison's chronometers, and practically brought them to their present form.[2]

Many of the clocks and watches made by these and other skilled mechanicians of the period are still keeping good time, and the work of these men, though sometimes a little lacking in finish, will bear comparison, not only with that of their contemporaries in other countries, but with that of any who have succeeded them.[3]

Salt.

In mediæval England salt was important rather as a food preservative than as a condiment, as it provided the only known means of keeping meat and fish in an edible condition. As Thorold Rogers points out,[1] for five or six months in the year the majority of people lived on salted provisions. They had to eat salted meat or go without meat at all. In Lent everybody had to live on salt fish—an unwholesome diet, which was a fruitful source of disease. The salt, which was always more or less impure, and often dirty, was originally obtained from sea-water all round the coast, evaporated first by solar heat and afterwards by fuel. The manufacture of salt was among the earliest applications of coal. The process was carried out sometimes in pans or ponds with clay bottoms, but in later years in metal evaporating pans heated by coal. Sussex, Devonshire, Shields, Bristol, Southampton, all had large salt works. From the southern coasts salt was exported to France, whence, centuries before, when the manufacture had depended on the heat of the sun, it had been imported.

The brine springs at Droitwich were certainly utilised before the early part of the eighteenth century. The salt-bearing strata at Northwich are said to have been discovered in 1670 in the course of boring for coal.

It is to be remembered that the idea of making soda from salt, the foundation of all modern chemical industry, had not yet been realised, though it was perhaps in the air. A little later Roebuck, the friend of Black and the associate of Watt, who was the founder of the great Carron works in Scotland and the first maker of sulphuric acid on a commercial scale, ruined himself by various speculations, amongst which was one for making soda from salt.[2]

Saltpetre.

Saltpetre or nitre (nitrate of potash) was a very important product, since it was a principal ingredient in the manufacture of gunpowder. It was also used in glass-making and for other purposes. It was first imported from the East, India and Persia. It was made in England and elsewhere in Europe, where it does not occur as a natural product, in "nitre heaps." These nitre heaps were composed of mixtures of animal excrement with wood ashes and lime. The process dates from the time of Elizabeth, when a German named Honrick discovered to the Queen for a sum of 300*l.* the secret of making "artificial saltpetre." The heap was watered with urine, and after a sufficient time the material was lixiviated, and the salt crystallised out. As time went on, native saltpetre was imported in considerable quantities, and the need for the strenuous search for saltpetre materials passed away, but much was obtained from the nitre heaps at the date with which we are concerned.

Gunpowder.

The earliest English gunpowder mills were those established at Long Ditton, in Surrey, by George Evelyn (John Evelyn's grandfather) about 1590. Another very important powder factory was that at Chilworth, established about 1654 by the East India Company, or leased by them about that time.[3] This changed hands several times, was flourishing in the middle of the eighteenth century, and is still at work. There were also mills at Dartford and at Battle, in Sussex. Defoe tells us that the best powder in the country was made at Battle. The materials, saltpetre, charcoal, and sulphur, in the same proportions as in modern black powder, were crushed in mills driven by water-power, pestles being used, and later stones. The Waltham Abbey mills, started early in the seventeenth century, were purchased by Government in 1787. The method of manufacture remained unchanged from a very early date until quite recent times, and until the introduction of modern powerful explosives.

Copperas.

Copperas (green vitriol, or sulphate of iron) was made at many places in England, and was a product of considerable importance. It was used in the manufacture of ink, in dyeing, and as a source of sulphuric acid (oil of vitriol). A certain amount of it was obtained in the manufacture of alum from shale, but the bulk of it was

[1] Nesbitt, "Glass Vessels in the South Kensington Museum" (1878); Hartshorne, "Old English Glasses"; "Encyclopædia Britannica," &c.

[2] F. J. Britten, "Former Clock and Watch-makers" (1894).

[3] The clock in the meeting room of the Royal Society of Arts was presented to the society in 1760 by Thomas Grignon (1740–84), a clockmaker of considerable reputation in his time. It is still an admirable time-keeper, and seems none the worse for its hundred and fifty years' service.

[1] "Six Centuries of Work and Wages," vol. ii., p. 95.

[2] Smiles, "Lives of Boulton and Watt," p. 152; "Industrial Biography p. 135; "Dict. Nat. Biog.," Roebuck.

[3] "Victoria County Histories (Surrey)," vol. ii., p. 318.

obtained from iron pyrites. The pyrites (sulphide of iron), or "gold stones," as it was termed, was stacked in heaps and allowed to weather. The drainings from the heap were boiled, with some iron added, and evaporated, the sulphate of iron crystallising out. There were important and old-established works at Deptford, Rotherhithe, and Whitstable. About 1754, works were established at Wigan.

Sulphuric Acid.

Sulphuric acid, known as "oil" or "spirit" of vitriol, was obtained by two processes, both invented by the alchemist Basil Valentine in the fifteenth century. In one of these crystals of sulphate of iron ("copperas") were distilled in earthen retorts, the resulting oil of vitriol being condensed in glass or earthenware receivers. The process is still employed at Nordhausen, in Saxony, and Nordhausen, or "fuming" acid, is still an article of commerce. It differs slightly in its chemical composition from the ordinary modern acid. The second process is the original form of the modern method. In it sulphur was burned under a bell-jar over water, and the acid liquor evaporated. Valentine also burnt a mixture of sulphur, nitre, and antimony sulphide in the same way, and this was an important improvement. About the middle of the eighteenth century a French chemist found that the antimony was not needed, and considerable amounts of the acid were then made.

Up to the middle of the eighteenth century all, or nearly all, the oil of vitriol made in England was made by the distillation of copperas, but in 1740 Ward introduced its manufacture by the method of burning sulphur and saltpetre. In 1749 he obtained a patent for the process. He set up works for making the acid, first at Twickenham and afterwards at Richmond. Dr. Roebuck improved on the process by substituting lead chambers for the glass receivers, and by this important modification the evolution of the modern method was practically completed. Roebuck and his partner, Garbett, first used their improved system in 1746 at Manchester, and in 1749 they set up work at Preston-Pans, near Edinburgh. This invention revolutionised the industry, greatly lowered the cost of production, and, among other applications, enabled the acid to be used for bleaching instead of the sour milk previously employed.

The method used at the present day for the manufacture of the vast quantities of sulphuric acid now required is really only a development of Roebuck's. The principle is the same, though it has been changed by chemical knowledge from an empirical manufacture to a highly scientific process. Iron pyrites (sulphide of iron) has generally replaced the sulphur first used, details have been improved, and the methods rendered more economical, but it remains in its essential features almost identical with that of a hundred and fifty years ago.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—An exhibition of 50*l.* a year, tenable for two years, is offered by the governing body of Emmanuel College to an advanced student commencing residence at Cambridge as a member of Emmanuel College in October. The exhibition will be awarded at the beginning of October. Applications, accompanied by two certificates of good character, should be sent to the Master of Emmanuel not later than October 1.

The chairman of the special board for biology and geology gives notice that applications to occupy the University's table in the Zoological Station at Naples, or that in the laboratory of the Marine Biological Association at Plymouth, should be addressed to him (Prof. Langley) on or before Thursday, May 26.

It is proposed to appoint a syndicate to consider the financial administration of the various scientific departments of the University and the financial relations between these departments and the museums and lecture rooms syndicate; that the syndicate confer with the financial board, the general board of studies, the museums and lecture rooms syndicate, the heads of the various scientific departments, and such other bodies or persons as they may think fit; and that they report to the Senate before the end of the Lent term, 1911.

At the Congregation to be held at 2 p.m. to-day, April 28, it is proposed to confer the degree of Doctor of Law, *honoris causa*, upon Colonel Theodore Roosevelt.

Prof. Senier delivered a lecture on March 9 last before the Royal Dublin Society on "The University and Technical Training," which has now been published by Mr. Edward Ponsonby, of 116 Grafton Street, Dublin. The lecture formed the subject of a note in our issue of March 24 last (vol. lxxxiii., p. 118).

Mr. Milton C. Whitaker, general superintendent of the Welsbach Company's works, has been appointed professor of industrial chemistry at Columbia University, to the vacancy caused by the retirement of Prof. Charles F. Chandler. Dr. Marston Taylor Bogert has been appointed to succeed Dr. Chandler as head of the department of chemistry.

The annual conference of the Association of Teachers in Technical Institutions will be held this year at Birmingham on May 16–17. Among the subjects for discussion are technical universities, relation of evening continuation schools to technical institutions, registration, superannuation of technical teachers, &c. An address will be given by Mr. Cyril Jackson, chairman of the Education Committee of the London County Council, on the extension of day technical work, and a paper will be read by Dr. T. Slater Price on the relation of technical institutions to universities.

The second International Conference on Elementary Education is to be held at the Sorbonne, Paris, on August 4–7. It is being organised by an International Bureau, consisting of representatives of the various associations of teachers throughout Europe. Among the subjects to be discussed by the conference may be mentioned the aim and object of elementary science teaching in primary schools; compulsory attendance; the professional training of teachers, inspectors, and educational administrators; and educational continuation work. Further information may be obtained from Mr. Ernest Gray, 67 Russell Square, London, W.C.

In connection with the appeal for 70,000*l.* for the purchase of a site and the erection of new chemical laboratories thereon at University College, London, to which we directed attention in the issue of Nature for February 17 (vol. lxxxii., p. 462), the Lord Mayor has arranged a meeting of city men to be held at the Mansion House on May 10, at 4 p.m. The chair will be taken by the Lord Mayor, and the following gentlemen will speak:—the Earl of Rosebery (Chancellor of the University), the Earl of Cromer, Lord Avebury, Sir Felix Schuster (treasurer of University College), Dr. Miers (principal of the University), Sir Henry Roscoe (chairman of the appeal committee), and Sir William Ramsay, K.C.B.

The attention of the Chancellor of the Exchequer was directed on April 22 in the House of Commons to the grave difficulty experienced by local education authorities in respect of the grant for secondary education based on the reduced amount of the "whisky money" for the present year. The amount received by local education authorities for higher education under the Local Taxation (Customs and Excise) Act has become greatly diminished, and many authorities have had to consider the question of reducing their work for next year, particularly in regard to evening classes. As was pointed out in the House by more than one speaker, it is highly unsatisfactory that the grant for higher education should depend upon the consumption of whisky in the country. The Chancellor admitted that something ought to be done in the course of this year to put the revenue of these local authorities on a more dependable basis. He said the loss owing to the decrease in the whisky revenue was 253,000*l.*, and he suggested, on behalf of the Government, that half the land taxes—which, it is expected, will be, in respect of last year, 490,000*l.*—shall be allocated for the purpose of making good the deficiency; and, secondly, that the

Government shall undertake, when it makes the financial arrangements for the year, to put on a more satisfactory and stable basis the whole question of the existing subvention from Imperial sources.

In the House of Commons on April 20 a satisfactory and altogether sympathetic discussion on the care and education of adolescents indicated that the efforts of educationists during the past few years to instruct public opinion as to the need of a system of compulsory attendance at continuation schools have not been in vain. Mr. Whitehouse moved a resolution, which was subsequently agreed to, "That, in view of the relation of unemployment to adolescent and child labour, this House regards an improved educational system, with more adequate provision for the care and training of adolescents, as a matter of urgent necessity, and considers that the Imperial Exchequer should bear an increased share of the cost of this national service." The chief educational change which he advocated was a system of compulsory education at continuation schools from the time of leaving school until the age of seventeen or eighteen. Mr. S. H. Butcher, in seconding the resolution, pointed out that the great blot of our educational system is that with one hand we spend millions of money on elementary education, and with the other we throw away a large part of the results of that education. There is lavish expense on one side, sheer waste on the other. A system which can lead to such results is economically unsound and educationally ruinous. A change is needed in the curriculum, and that change ought to be in the direction of less insistence upon mere book work, more direct contact with nature, more manual training. The school age must be raised, whether it is to fifteen or to fourteen, and we must abolish, by degrees but ultimately altogether, half-time exemptions below thirteen. Mr. Trevelyan expressed sympathy with the resolution on behalf of the Board of Education. He pointed out that the present is a session in which the Board is not required to produce any legislation, but he said the Board is prepared to move in several directions if time, money, and public opinion are favourable. A drastic method of dealing with street trading, the abolition of the half-time system, the raising of the school leaving age, and the encouragement of attendance at continuation schools, were instanced as subjects on which the Board has been at work and is prepared to act.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 21.—Sir Archibald Geikie, K.C.B., president, in the chair.—Lord **Rayleigh**: The incidence of light upon a transparent sphere of dimensions comparable with a wave-length. The investigation is on the basis of the electromagnetic theory of light, the transparent sphere being supposed to have a dielectric constant different from that of the surrounding medium. The case of a very small sphere, or of an obstacle of any size and shape under the restriction of very small refractivity, was treated in 1881. In the numerical calculations of the present paper the refractive index is supposed to be 1·5, and the ratio of circumference to wave-length has the values 1, 1·5, 1·75, 2, and 2·25. When the ratio in question is small and the incident light is unpolarised, the scattered light is polarised in all directions except, of course, those parallel to the incident ray; and the polarisation is complete at right angles to the primary ray. As the ratio increases, this condition of things is departed from. The maximum polarisation is now to be found in an oblique direction, inclining backwards. A little later the polarisation in certain directions is reversed, such changes occurring very rapidly as the ratio alters. Experiments similar to those made in 1881 upon sulphur particles precipitated from a dilute and acidified solution of "hypo" are described, and it is shown that a passage from red to blue light may reverse the polarisation, although there is no change either in the liquid or in the direction of observation.—Prof. Karl **Pearson**: The improbability of a random distribution of the stars in space.—Dr. R. D. **Kleeman**: The total ionisation produced in different gases by the kathode rays ejected by X-rays. The results are given in the annexed table, in which are also placed the total ionisations obtained by Prof. Bragg with the α particle. It will be seen that the two sets of values relative to air are very nearly the same. The energy spent in making an ion thus seems not to depend in any marked degree on the nature of the ionising agent.

	Kathode Rays	α particle
Air	1·00	1·00
Carbon dioxide (CO_2) ...	1·08	1·08
Ethyl oxide ($C_4H_{10}O$) ...	1·23	1·32
Pentane (C_5H_{12})	1·31	1·35
Benzene (C_6H_6)	1·20	1·29
Ethyl chloride (C_2H_5Cl) ...	1·33	1·32
Chloroform ($CHCl_3$) ...	1·34	1·29

—Prof. F. J. **Cole**: Tone perception in *Gammarus pulex*. The paper has reference to the occurrence of a definite and visible physiological response on the part of the freshwater amphipod *Gammarus pulex* to stimuli of an auditory character. Audition in the lower animals cannot be satisfactorily studied in most cases, since a stimulus produces no response that can be seen or measured. Gammarus, however, when confined in a microscope live box, responds in an energetic and striking manner by flexing its first pair of antennæ under its body. A response can be elicited after the second pair of antennæ have been removed, but not after the removal of the first pair. The instrument generally used to produce the stimulus was a tenor trombone, and the experiments were conducted either on the ordinary laboratory table or on a table specially constructed to filter off vibrations from the ground, and thus to ensure that the stimulus reached the animal through the air. It was found that Gammarus was most sensitive to the B flat below middle C, and that its range of tonal sense was so limited that it might almost be adduced as an example of absolute or physiological tonality, *i.e.* of an animal specially sensitive to one note. Only a small percentage of individuals, however, responded at all, and then, probably owing to fatigue, the power of response soon disappeared. One specimen responded to every note of the trombone. The experiments may be interpreted as either tactual or auditory reactions—if it can be held that these two senses have segregated out in such a simple and true aquatic species as *Gammarus pulex*, and do not merely form a part of an indefinite common sensibility.

Geological Society, April 13.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. Tempest **Anderson**: The volcano of Matavanu in Savaii. Savaii is one of the German Samoan Islands. It is volcanic, formed of varieties of basic lavas, and for the most part fringed with coral reefs. The volcano of Matavanu was formed in 1905. The eruption was at first explosive, but since the first few weeks has been mainly effusive and accompanied by the discharge of fluid basic lava, which has run by a devious course of about ten miles to the sea, formed fields of both slaggy and cindery lava, filled up a valley to a depth in some places of probably 400 feet, and devastated the most fertile land in the island. The crater contains a lake, or rather river, of incandescent lava, so fluid that it beats in waves on the walls, rises in fountains of liquid basalt, and flows with the velocity of a cataract into a gulf or tunnel at one end of the crater. It then runs underground until it reaches the sea, into which it flows, and causes explosions attended with the discharge of showers of sand and fragments of hot lava, and the emission of clouds of steam. The resemblances to, and few differences from, the volcano of Kilauea are discussed.—Helen **Drew** and Ida L. **Slater**: Notes on the geology of the district around Llansawel (Carmarthenshire). The stratigraphy and geological structure of a small area some nine miles to the west of Llandovery, and to the north of Llandeilo, are dealt with. The rocks consist of a series of sediments, including a coarse conglomerate, grits, shales, and tough blue mudstones. The structure in the eastern part of the district is more complicated than in the west. The repeated outcrops of the conglomerate in the hilly region around Shon Nicholas give the clue to the structure. The paper concludes with a comparison of this district with those of Rhayader and Pont Erwyd.

FORTHCOMING CONGRESSES.

MAY 14-22.—International Botanical Congress. Brussels. General Secretary: Dr. E. de Wildeman, Jardin botanique, Bruxelles.

MAY 16-21.—International Congress of Americanists. Buenos Ayres. General Secretary: Dr. Lehmann-Nitsche, Calle Viamonte 430, Buenos Ayres, Argentine Republic.

MAY 20-23.—International Congress of Tropical Agriculture. Brussels. Secretary of British Committee: Dr. T. A. Henry, Scientific and Technical Department, Imperial Institute, S.W.

MAY 30 TO JUNE 4.—International Ornithological Congress. Berlin. President: Prof. A. Reichenow. Address for inquiries: Berlin N 4, Invalidenstr. 43.

JUNE.—International Congress of Mining, Metallurgy, Applied Mechanics and Practical Geology. Düsseldorf. General Secretaries: Dr. Schrödter and Mr. Löwenstein, Jacobi-strasse 3/5, Düsseldorf, Germany.

JULY 10-25.—International American Scientific Congress. Buenos Aires. Address for inquiries: President of the Executive Committee, c/o Argentine Scientific Society, 269 Calle Cevallos, Buenos Aires.

JULY 27-31.—International Congress on the Administrative Sciences. Brussels. Secretary of British Committee: Mr. G. Montague Harris, Caxton House, Westminster.

AUGUST 1-6.—International Congress of Entomology. Brussels. Chairman of Local Committee for Great Britain: Dr. G. B. Longstaff, Highlands, Putney Heath, S.W.

AUGUST 1-7.—French Association for the Advancement of Science. Toulouse. President: Prof. Gariel. Address of Secretary: 28 rue Serpente, Paris.

AUGUST.—International Congress of Photography. Brussels. Correspondent for United Kingdom: Mr. Chapman Jones, 11 Eaton Rise, Ealing, W.

AUGUST 2-7.—International Congress on School Hygiene. Paris. General Secretary: Dr. Dufestel, 10 Boulevard Magenta, Paris.

AUGUST 15-20.—International Zoological Congress. Graz (Austria). President: Prof. Ludwig von Graff. Address for inquiries: Präsidium des VIII. Internationalen Zoologen-Kongresses, Universitätsplatz 2, Graz (Österreich).

AUGUST 18-26.—International Geological Congress. Stockholm. General Secretary: Prof. J. G. Andersson, Stockholm 3.

AUGUST 29 TO SEPTEMBER 6.—International Union for Cooperation in Solar Research. Mount Wilson Solar Observatory. British Member of Executive Committee to whom inquiries should be addressed: Prof. A. Schuster, F.R.S., Victoria Park, Manchester.

AUGUST 31 TO SEPTEMBER 7.—British Association. Sheffield. President: Prof. T. G. Bonney, F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

SEPTEMBER 6-8.—International Congress of Radiology and Electricity. Brussels. General Secretary: Dr. J. Daniel, 1 rue de la Prévôte, Brussels. Correspondents for United Kingdom: Prof. Rutherford and Dr. W. Makower, University of Manchester, and Dr. W. Deane Butcher, Holyrood, Ealing, W.

SEPTEMBER 18-24.—German Association of Naturalists and Physicians. Königsberg. Secretaries: Prof. Lichtheim and Prof. F. Meyer, Drummstr. 25-29, Königsberg.

SEPTEMBER 27-30.—International Physiological Congress. Vienna. President: Prof. S. Exner. General Secretary for United Kingdom: Prof. E. B. Starling, University College, London, W.C.

OCTOBER 6-12.—Congrès International du Froid. Vienna. Correspondent for United Kingdom: Mr. R. M. Leonard, 3 Oxford Court, Cannon Street, E.C.

DIARY OF SOCIETIES.

THURSDAY, APRIL 28.

ROYAL SOCIETY, at 4.30.—On the Rotatory Character of some Terrestrial Magnetic Disturbances at Greenwich, and on their Diurnal Distribution: R. B. Sangster.—The Liberation of Helium from Minerals by the Action of Heat: D. O. Wood.—The Chromophil Tissues and the Adrenal Medulla: Prof. Swale Vincent.

ROYAL INSTITUTION, at 3.—Blackfeet Indians in North America: Walter McClintock.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Earthed *versus* Insulated Neutrals in Colliery Installations: W. W. Wood.

MATHEMATICAL SOCIETY, at 5.30.—The Accuracy of Interpolation by Finite Differences: Dr. W. F. Sheppard.—Note on Maclaurin's Test for the Convergence of Series: G. H. Hardy.

FRIDAY, APRIL 29.

ROYAL INSTITUTION, at 9.—Matavanu: a New Volcano in Savaii (German Samoa): Dr. Tempest Anderson.

SATURDAY, APRIL 30.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

MONDAY, MAY 2.

ROYAL INSTITUTION, at 5.—Annual Meeting.

VICTORIA INSTITUTE, at 4.30.—Annual General Meeting.

ARISTOTELIAN SOCIETY, at 8.—The Emotional Experiences of some Higher Mystics: Rev. A. Caldecott.

ROYAL SOCIETY OF ARTS, at 8.—Modern Methods of Brick-making: Dr. A. B. Searle.

SOCIETY OF ENGINEERS, at 7.30.—Up-to-date Roads: R. O. Wynne-Roberts.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Principles of Tanning: Dr. J. Gordon Parker.—The Crystalline Products of the Hydration of Portland Cement: E. F. Read.

TUESDAY, MAY 3.

ROYAL INSTITUTION, at 3.—The Mechanism of the Human Voice: Prof. F. W. Mott, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—Commercial Expansion within the Empi[illegible] P. J. Hannen.

ZOOLOGICAL SOCIETY, at 8.30.—(1) The Morphology and Life-history of *Eimeria* (*Coccidium*) *avium*: a Sporozoön causing a Fatal Disease among Young Grouse; (2) Observations on the Parasitic Protozoa of the Red Grouse (*Lagopus scoticus*); (3) Experimental Studies on Avian Coccidiosis, especially in Relation to Young Grouse, Fowls, and Pigeons; (4) Observations on the Blood of Grouse: Dr. H. B. Fantham.—Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904-1905. Report on the Ostracoda: Prof. G. O. Sars.—On Tritylodon, and on the Relationships of the Multituberculata: Dr. R. Broom.

WEDNESDAY, MAY 4.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Composition of Milk; Note on Commercial Detergents: H. Droop Richmond.—Uses of Trichlorethylene in Chemical Analysis: L. Gowing Scopes.—A Convenient Fat Extraction Apparatus: W. Clacher.—An Extraction Apparatus: G. S. Walpole.

ROYAL SOCIETY OF ARTS, at 8.—Halley and his Comet: Prof. H. H. Turner, F.R.S.

ENTOMOLOGICAL SOCIETY, at 8.—Descriptions of Micro-Lepidoptera from Mauritius: E. Meyrick, F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 8.45.—My Expedition to the North Pole: Commander R. G. Peary.

THURSDAY, MAY 5.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Development of Trypanosomes in Tsetse Flies: Col. Sir D. Bruce, C.B., F.R.S., Captains A. E. Hamerton and H. R. Bateman, R.A.M.C., and Captain F. P. Mackie, I.M.S.—On the Weight of Precipitate obtainable in Precipitin Interactions: Dr. H. G. Chapman.—The Absorption of Gases by Charcoal: Miss Homfray.

ROYAL INSTITUTION, at 3.—Blackfeet Indians in North America: Walter McClintock.

RÖNTGEN SOCIETY, at 8.15.—Quantitative Measurements of the Conversion of Kathode Rays into Röntgen Rays by Antikathodes of Different Metals: J. H. Gardiner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—A Telephone Relay: S. G. Brown.

LINNEAN SOCIETY, at 8.—Eight Months' Entomological Collecting in the Seychelles Islands: Hugh Scott.—The Anatomy of *Tipula maxima*: J. M. Brown.

FRIDAY, MAY 6.

ROYAL INSTITUTION, at 9.—Auto-inoculation: Sir Almroth E. Wright, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The History of the Study of Fossils: Dr. A. Smith Woodward, F.R.S.

SATURDAY, MAY 7.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

CONTENTS.

THURSDAY, MAY 5, 1910.

CRYSTALLOGRAPHIC RESEARCHES.

Crystalline Structure and Chemical Constitution. By Dr. A. E. H. Tutton, F.R.S. Pp. viii+204. (London: Macmillan and Co., Ltd., 1910.) Price 5*s*. net.

THE series of science monographs projected by Messrs. Macmillan and Co. has opened auspiciously with a fascinating account by Dr. Tutton of the exhaustive crystallographical researches upon which, for the past twenty years, he has been engaged. It is a goodly story that he has to tell, and well is it told; without wearying the reader with an unwieldy mass of details, he presents in all essential completeness a vivid picture of an unusually coherent series of investigations. The immensity of the labour involved can be fully appreciated only by those who may have undertaken work of somewhat similar character, but the most casual reader can scarcely fail to be amazed at the extraordinary amount of work the author has contrived to squeeze into the leisure hours of a busy official life; by strenuously utilising every spare moment he has found time to accomplish a task which has set an ideal of what a complete study of the physical properties of crystallised substances should be. Those at least who have at heart England's position in the world of science are grateful to Dr. Tutton that, thanks largely to his efforts, in crystallography, at any rate, she stands so high.

Dr. Tutton completed his scientific training, and was looking round for a field for research at an opportune moment. It was at that time being increasingly felt by those speculating on the molecular arrangement of crystals that little real advance could be made towards a solution of the problem until more numerous and more accurate measurements of crystallised substances, especially those constituting isomorphous groups, were available. Principal Miers had already published his important memoir upon the characters of the red-silver minerals, pyrargyrite and proustite. From that and similar work it seemed clear that small, but perceptible, differences existed between the crystalline forms of the constituents of an isomorphous series; in fact, the conclusion established by Dr. Tutton's investigations was not so wholly unforeseen at that date as might be supposed from the opening pages of his book. It was, however, very desirable that research of a similar, and, if possible, more comprehensive, character should be extended to artificial salts, because in such the purity of the material, and the perfection of the crystals, could be secured with far greater certainty than when the process had been in nature's unfettered control. To an investigation of this kind Dr. Tutton determined to devote himself, and he selected for his initial task the three members containing potassium, rubidium, and cæsium of the isomorphous group of which $K_2Mg(SO_4)_2,6H_2O$ may be taken as a type; their crystalline form had not previously been properly studied.

It was part of Dr. Tutton's design that his research should be carried out with instruments as perfect as mechanical skill could produce. He found, indeed, at hand a most efficient goniometer for the measurement of interfacial angles of crystals, but, when he came to the determination of the optical and other vectorial characters, he was compelled to design an entirely novel equipment, since nothing of the requisite standard had hitherto been constructed. The first of these instruments was a grinding and cutting goniometer, by means of which it was possible to prepare sections and prisms with absolute confidence in the accuracy of their orientation in the crystal. The natural faces are seldom suitably developed for optical research, and the lapidaries' method was far too untrustworthy for Dr. Tutton's standard. This apparatus naturally called for a companion instrument, which should provide light of any desired colour at will. Sodium light, which is adopted as the standard in all measurements of refractivity, is, of course, readily available, but no optical investigation can be considered complete unless the colour dispersion has also been studied; previously crystallographers had been restricted to the lithium and thallium flames, of which the latter is actually poisonous, and, moreover, the study of interference figures often demanded light of intermediate wave-lengths. Dr. Tutton accordingly designed a most efficient monochromatic illuminator, in which the dispersive agent is a single prism of very dense glass. Spurred by the success achieved, he proceeded next to plan, using the principle of the interference of light, an instrument of extraordinary delicacy for the measurement of variations in length. He himself employed it in conjunction with the necessary additional apparatus, which he fully describes, for the measurement of thermal expansion and elasticity constants, and an interferometer of his design was recently installed in the Standards Department of the Board of Trade (NATURE, vol. lxxxii., p. 338). The whole of Dr. Tutton's instrumental apparatus has been characterised by the painstaking care bestowed upon those apparently small details which have such an important bearing upon efficiency of performance.

As already stated, Dr. Tutton opened his researches with a study of the crystalline form of the double sulphates of potassium, rubidium, and cæsium, with magnesium. He subsequently extended his investigation to similar compounds of ammonium and thallium, which were found to possess closely related properties, and also to the corresponding selenates. Up to date he has studied the sulphates and selenates, and many of the double sulphates and selenates with magnesium, zinc, iron, nickel, cobalt, copper, manganese, and cadmium. Altogether forty-four salts—Dr. Tutton gives the number as fifty-four, but appears to have inadvertently reckoned ten of them twice—have been prepared and investigated, the greatest possible care being taken to ensure their purity and perfection of development; no fewer than 25,000

angles were measured, and upwards of four hundred sections, and the same number of prisms, have been cut. The optical study incidentally raised some interesting points in connection with the phenomenon known as crossed-axial-plane dispersion. Beautiful photographs of the interference figures given by cæsium magnesium sulphate in light of different wave-lengths at ordinary temperatures and at 78° are reproduced on p. 169. The thermal expansion of the sulphates of potassium, rubidium, and cæsium alone have as yet been determined; the exacting nature of this work may be gathered from the remark on p. 71 that each series of observations, sixty-four in all, entailed five hours' continuous labour.

Certain definite conclusions have been established by Dr. Tutton's work. The variation in the morphological and physical properties of the members of the same isomorphous series, though slight, is progressively related to the atomic weights in the case of the three elements belonging to the same family group. The relations between members containing these elements are, indeed, so intimate that they may be regarded as forming an inner circle—a eutropic series, as it is termed—within the isomorphous series; members containing ammonium and thallium, though undoubtedly belonging to the same isomorphous series, show greater deviations from the general properties. Corresponding changes of the same order, but in the reverse direction, take place when selenium is substituted for sulphur. The results are so tabulated that the relations and differences are easily grasped.

Throughout the book Dr. Tutton has realised the importance of not intruding upon observed facts about which no possible doubt could be raised any speculative matter which might be open to dispute, and he refrains from dwelling at any great length upon the many interesting questions relative to molecular arrangement which are suggested by the results of his investigations. He does, however, argue that the possibility of ammonium replacing a single atom without much effect upon the crystalline form is incompatible with Barlow's theory of close-packing, which has recently been attracting so much attention. On the other hand, Pope and Barlow, in their first paper, discussed the isomorphism of potassium chloride and ammonium chloride, and showed that the relationship in this case was in strict consonance with the close-packing of the spheres of influence. Close-packing is, indeed, merely a way of representing the state of equilibrium between the mutual interactions of atomic forces emanating from definite centres; it is difficult to attach any physical significance to loose-packing in connection with crystalline structure.

Enough has been written to show that the book is one that should be read and studied by all interested in crystals, their properties, and their formation. Finally, we hope that Dr. Tutton may enjoy, for many years to come, health and strength to carry on the splendid work that constitutes his recreation.

SOIL MANAGEMENT AND PLANT GROWTH.

The Principles of Soil Management. By Profs. T. Lyttleton Lyon and E. O. Fippin. Pp. xxxiii+531. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1909.) Price 7*s.* 6*d.* net.

THIS book is the first of a new series designed by Dr. Bailey for "class-room work and for special use in consultation and reference," and the volumes are therefore larger and fuller than those of the Rural Science Series, which were meant for general reading and popular use. In the present series the subject is to be presented in such a way that it shall develop "clear thinking, sound argument, constructive imagination, and effective application to the needs of life."

Dr. Bailey contributes a vigorous introduction, strong in its condemnation of our present lack of interest in soil problems.

"We are accustomed," he says, "to think of the power of man in gaining dominion over the forces of nature,—he bends to his use the expansive powers of steam, the energy of electric currents, ... but while he is doing all this he sets at naught the powers in the soil beneath his feet, wastes them, and deprives himself of vast sources of energy."

Among the national resources that demand conservation the soil takes a high rank.

Turning to the volume itself, the subject is treated under seven headings; the soil is considered as a medium for root development; as a reservoir for water; as a source of plant food; the organisms of the soil are studied, the composition of the soil air, and the relation of soil to temperature. Finally, methods of soil management are discussed. The general idea is to treat the soil as a medium for plant growth, to regard it from the agricultural and not so much from the geological point of view. There is, of course, no particular novelty in this position, and several books have already been written in which the subject is dealt with in the same way; the arrangement of the matter therefore calls for no comment.

Liberal use is made of photographs to illustrate the various points brought up, and there are some very good photomicrographs showing the structure of certain common rocks. A considerable amount of time and trouble must have been spent on these, and also on the tables of figures which have been pretty freely introduced. The results obtained at the various experiment stations in the United States have been drawn on, and a good deal of material is collected that will be new to the English reader and interesting to the American student.

But when all this is said, it must be admitted that the book somehow leaves an unsatisfactory impression. In spite of the attractiveness of the subject, the present writer has to confess that he found the volume rather boring. It is hardly a book that the American student would "enthuse" about, and it does not adequately repay all the labour that must have been bestowed upon it. We somehow get a suspicion that the authors have searched more amongst the latest text-books and the latest bulletins

than amongst the depths of the subject they are expounding, and so the book lacks that invigorating freshness that can only be given by men who are for ever probing the secrets of nature and working among the things they talk about—its atmosphere is wrong.

We cannot help thinking that the authors would have obtained much better results had they worked on the model set many years ago by Johnson, one of the best writers on agricultural chemistry the United States, or, for that matter, any other country, ever produced. He sets before the student accounts of the investigations that have made the subject, shows pictures of the apparatus used in the classical experiments, and gives some details of the actual working. The result is a book that after forty years still retains its freshness and its power of inspiration, because it shows how men have wrestled with nature to win her secrets. If when a second edition of the present book is called for the authors would, in a similar way, make room for some of the classical work of the great masters, without extending the size of the book, it is certain that their industry and painstaking efforts would meet with a more fitting reward.

E. J. R.

MECHANICS OF HEREDITY.

Das Vererbungsproblem im Lichte der Entwicklungsmechanik betrachtet. By Prof. E. Godlewski, Jun. (Being Part ix. of Roux's "Vorträge und Aufsätze über Entwickelungsmechanik.") Pp. 301. (Leipzig: W. Engelmann, 1909.) Price 7 marks.

IN this book the author attempts a critical review of our knowledge of the mechanism by which hereditary characters are transmitted, and makes it his chief object to distinguish clearly between ascertained facts and the inferences based upon them. Part i. contains an outline of the facts of heredity, only so much being given as is necessary to an understanding of their relation with developmental mechanics. The possible inheritance of "acquired" characters is discussed, inheritance in non-sexual reproduction, including an account of Winckler's recent work on graft-hybrids, and, finally, inheritance in sexual reproduction. This is classified under the heads of blended, mosaic, and alternative. Under mosaic heredity, cases like Toyama's gynandromorphic silkworm are included, which seems scarcely justifiable. Under alternative inheritance and Mendel's law the author seems not thoroughly to grasp the independence of the facts of dominance and segregation, and the same want of clearness in this respect reappears in the general summary. Also in discussing the relations of the different forms of heredity we note a couple of slips in his account of Galton's and Pearson's statements of the law of ancestral heredity.

In part ii. the author is more completely master of his subject. Essentially the problem to be solved is whether a substance which determines the appearance of inherited characters exists and is transmitted from generation to generation; if so, where it is localised and how it acts, so as to produce the different kinds of heredity found in different characters in the same or different organisms. The theory originally made familiar by Roux and Weismann, that the nucleus, and especially the chromosomes, are the "bearers of heredity," is first discussed, and the work of Driesch and his hypothesis of "Entelechy" are explained, and, finally, the theories of Semon and others are reviewed. It is pointed out that writers are divided into two schools—those who believe in a transmitted substance as the basis of inheritance, and those who regard such a substance as a medium for the action of inherent properties. The next four sections deal with work which seeks to discover a transmitted substance, and especially with work on the nucleus. Recent work on amitosis, the structure of the germ-cells, and the facts of fertilisation leads the author to conclude that from these phenomena no "nuclear monopoly" in inheritance can be deduced. A review of recent work on the chromosomes leads to the same conclusion; although their constancy in number and form for each species is admitted, Fick's "Manövrierhypothese" is regarded as equally consistent with the facts with Boveri's theory of individuality. Perhaps insufficient weight is attached to the work, especially of American cytologists, on the behaviour of the chromosomes in the maturation divisions, and in the general summary the author admits that he regards the appearance of their conjugation, and of the relative independence of paternal and maternal elements, as illusory. Since the reality and cause of Mendelian segregation is nowhere fully discussed, this question might have been treated more completely with advantage.

Perhaps the most important section of the book deals with experimental work on hybridisation and fertilisation of non-nucleated fragments (Boveri, Seeliger, Delage, &c.), combination of artificial parthenogenesis and hybridisation (Herbst), and the results of polyspermy (Boveri). These experiments are very thoroughly described, and the conclusion is arrived at that from them also no evidence for nuclear monopoly is obtainable. That the nucleus is of primary importance is proved, but the relations between nucleus and cytoplasm, rather than the nucleus itself, are regarded as the basis of heredity. At the end of this section a summary of the evidence for the action of the cytoplasm is given; although relatively little work has been done in this field, yet one feels that the treatment is rather meagre compared with that devoted to the nucleus.

In the last sections are discussed the nature of the determining substances (possibly enzymes, &c.), and work on the influences of external factors on changing the "Vererbungsrichtung." The work of Guthrie and Magnus on transplantation of ovaries is mentioned, but the author does not seem to know the paper of Tower on the beetle Leptinotarsa.

The book, on the whole, is eminently readable, and succeeds well in its difficult task of summarising the results of recent work and of disentangling ascertained fact from deduction. The author regards experimental facts as the only legitimate proofs of the basis of heredity, and a tendency to be perhaps

unduly critical of all other evidence is a fault on the right side. He has succeeded in including work which appeared almost up to the time of publication of the book, and has produced a most valuable account of what is known of the subject.

AMERICAN GEOLOGY.

Geology: Shorter Course. By Thomas C. Chamberlin and Rollin D. Salisbury. Pp. xviii+978. (London: John Murray, 1909.) Price 21*s.* net.

A College Text-book of Geology. By the same. Pp. xviii+978. (New York: Henry Holt and Co., 1909.)

THESE are respectively the English and American editions of the same work, and each weighs 3 lb. 10 oz., without in any way approaching the dimensions of a German "Handbuch." We are not clear in this case if the insertion of an English title-page adds to the price of the work; but we note that the larger text-book by the same authors costs 63*s.* in London and 50*s.* in New York. This "shorter course" is not one that could be used in colleges in our island, except as a description of the geology of North America; while as a reference-book on this subject and on the valuable original views of the authors the larger work is manifestly superior.

It is a misfortune, which often must be felt in our own colonies, that text-books on natural history require a local setting and foundation; even the first 413 pages of Messrs. Chamberlin and Salisbury's shorter course, dealing with physical geology, are almost entirely illustrated from American sources, and are, of course, all the better on that account, in view of the intentions of the authors. Maps of the United States Topographic Survey are utilised effectively, as in Mr. Salisbury's treatise on physiography; and the photographs of landscape-features, such as the rippled sand-dune on p. 100, the Bad-land topography on p. 135, and the dust-cloud of Pélée on p. 381, are so beautifully reproduced that we cannot blame the publishers for their choice of heavy paper. "La Croix," by the by, in the description of the last-mentioned picture, should be Lacroix; "Gyrvan" on p. 406 is our Scottish Girvan; and "the Achäischen earthquake" on p. 348 is surely an accidental hybrid. The esker of Punkaharju, shown on p. 273, is not in Scandinavia, but in Finland. But there are very few misprints in this handsome volume.

The account of glacial phenomena is of especial interest, and the views of various writers as to glacier-motion are carefully stated (pp. 280–8). There is probably less difference between the views of Tyndall and James Thomson (not "Thompson") than is here suggested; Tyndall himself wrote in his "Forms of Water,"

"the gist of the Regelation Theory is that the ice of glaciers changes its form and preserves its continuity under *pressure,* which keeps its particles together."

He does not appear to have insisted upon actual fracture as *necessary* to glacier-motion.

Other interesting discussions are that of the planetesimal origin of the solar system, which is here concisely treated (p. 420), and that of the depth to which water from the surface may penetrate the earth (p. 197). Excellent diagrams are given of the effects of faulting and folding on the outcrops of strata on a level surface.

In the stratigraphical section of the book, we may note that an Archeozoic era is accepted, its rocks being in part sedimentary, but lying unconformably in most places beneath those of the Proterozoic (Algonkian) era. Diagrammatic maps after De Lapparent are given to show the distribution of certain strata in Europe; but their scale is too small to render them serviceable as guides. That of the Devonian system, for example, allows of the existence of only the Lower Devonian series in the British Isles, and the disposition of the Devonian lakes in Wales and Ireland is singularly capricious. Maps of North America are given for each system, usefully discriminating between actual outcrops and conjectural extensions.

The Carboniferous period is divided into a lower Mississippian and an upper Pennsylvanian period; the Cretaceous into Comanchean and Cretaceous proper. This last subdivision, however, raises exactly the same difficulties as the attempt to restrict Silurian to the upper part of the old Silurian system. European readers will gain greatly from the last half of the book. Though they cannot accept it as their only text-book of geology, they will recognise at all points the originality and perception of the authors.

G. A. J. C.

ELECTRIC WAVES IN THEORY AND PRACTICE.

(1) *Electric Waves. An Advanced Treatise on Alternating-current Theory.* By Prof. W. S. Franklin. Pp. x+315. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 3 dollars net (10*s.* net).

(2) *Wireless Telegraphy and Wireless Telephony. An Elementary Treatise.* By Prof. A. E. Kennelly. Second edition. Pp. vii+279. (London: T. Fisher Unwin, 1909.) Price 4*s.* net.

(3) *Wireless Telephones and How They Work.* By Dr. J. Erskine-Murray. Pp. iii+68. (London: Crosby Lockwood and Son, 1910.) Price 1*s.* 6*d.* net.

(4) *Handbook for Wireless Telegraph Operators.* Published for official use. October, 1909. Price 3*d.*

(1) PROF. FRANKLIN'S treatise, although by its title it might be expected to deal more particularly with that class of electric waves used in Hertzian telegraphy, deals with the whole subject of electromagnetic waves, and is more adequately described by its sub-title. Indeed, the subject of wireless telegraphy is given, if anything, less than its fair share of attention on the ground that it is already adequately treated in Fleming's "Principles of Electric Wave Telegraphy." It is to be wished that all authors showed a similar moderation and restraint. The volume opens, after a brief introductory chapter, with two chapters on water waves and wave trains, which serve as a useful introduction to the principal ideas of wave motion. The next four chapters deal

with the general mathematical theory of electromagnetic waves, with special reference to transmission and telephone lines, and in the sixth chapter Hertzian telegraphy is briefly discussed from the practical side. The next two chapters, forming the second part of the volume, deal with harmonic analysis and non-harmonic E.M.F.'s and currents, and bear directly on the problems met with in alternating-current machinery. The mathematics is advanced, and the book is only suitable for advanced students. In an appendix are given eighty-eight problems for the student to work out, and there are a number of very excellent diagrams.

(2) Prof. Kennelly describes his book as an elementary treatise; it covers both the theoretical and practical side of wireless telegraphy and telephony, and is admirably suited for the reader with only very slight technical knowledge. The exposition of the theoretical side is clear, and the description of practical methods, though short, is sufficient to give a general idea of the present position of the art. The only objection which we have to raise against the book is on account of the diagrams, which are numerous but far from clear. Those in the earlier part of the book especially are on so small a scale that they are practically unintelligible; this is the more to be regretted as the type and paper are excellent, and there is no apparent reason why the diagrams should not be equally well reproduced.

(3) Dr. Erskine-Murray's little book is a popular exposition of the methods and present position of wireless telephony. Dr. Erskine-Murray combines a thorough knowledge of his subject with the power of clear and simple explanation, and we know of no better book for those of the general public who are anxious to know how wireless telephony now stands. We are rather doubtful whether the somewhat rosy view of the future taken in the last chapter is likely to be realised, although the advances already made make one chary of expressing too strong a doubt.

(4) No stronger evidence of the assured position of wireless telegraphy as a commercial means of communication could be afforded than the publication of this little Government handbook. The book itself does not call for much comment, since it contains only instructions and regulations for operators on board ship or in coast stations, but that such regulations should be called for is a more convincing proof that wireless telegraphy has settled down to the steady enjoyment of its own kingdom than any number of treatises or popular booklets. The position of wireless telephony to-day is much the same as that of wireless telegraphy ten years ago. Will 1920 see the issue of a Government handbook for wireless telephone operators?

OUR BOOK SHELF.

The Liverpool Geological Society. A Retrospect of Fifty Years' Existence and Work. By W. Hewitt. Pp. 117. (Liverpool: C. Tinling and Co., Ltd., 1910.)

THE Liverpool Geological Society, which was established on December 13, 1859, has signalised its jubilee by the publication of this volume, which includes an account of the history of the society and its geological labours, a list of papers printed in the Proceedings, and biographical notices of some past members. The society originated from a meeting held at the residence of G. H. Morton, who was its real founder, and for about forty years the chief moving spirit among the members. A capital portrait of him is given. Well known as the author of a volume "On the Geology of the Country around Liverpool," and of a series of important papers on the stratigraphy and palæontology of the Carboniferous rocks of Flintshire, he was one of the most distinguished of provincial geologists. By regarding the country within fifteen miles of Liverpool as their proper sphere of study, the society took the Carboniferous limestone series of Flintshire as their foundation-rocks, together with the succeeding Millstone Grit, Permian, Trias, Pleistocene, and Recent deposits.

On all these formations the members of the society have done excellent work. Undoubted Permian strata, including a bed of magnesian limestone with Schizodus, were described by Mr. E. Dickson at Skiliaw Clough, near Parbold. The researches of the late T. Mellard Reade on the Triassic rocks, the Glacial Drifts, and the recent physical changes in the Lancashire district are well known. His portrait is included; also that of Dr. Charles Ricketts, another enthusiastic worker who dealt with many local physical problems. There is one other portrait, that of Joseph Lomas, who had done much in investigating the fauna, flora, and origin of the Trias. Unfortunately, a railway accident in Algeria terminated the life of this zealous and genial worker at the early age of forty-eight. Photographic plates are given of the famous footprints of Cheirotherium from the Keuper Sandstone of Storeton, in Cheshire, described by Morton; and of the gypsum boulder from the Glacial Drift of Great Crosby, described by Mellard Reade. The volume has been carefully prepared, and is a valuable and interesting record of the work of Liverpool geologists.

Catalogue of the Lepidoptera Phalaenae of the British Museum. Vol. ix. Catalogue of the Noctuidæ in the Collection of the British Museum. By Sir George F. Hampson, Bart. Pp. xv+552; plates cxxxvii-cxlvii. (London: Printed by Order of the Trustees British Museum [Natural History]; Longmans and Co.; B. Quaritch; Dulau and Co., Ltd., 1910.) Catalogue 15*s.*; plates, 12*s.*

WE have again to congratulate the authorities of the British Museum and the indefatigable author on the appearance, within less than a year, of another volume of this highly important descriptive catalogue of moths. It is the sixth which has been devoted to the Noctuidæ, and is the third and last volume dealing with the great subfamily Acronyctinæ, of which 385 genera and 2288 species (a large proportion new) are described, and a great number illustrated in the three volumes devoted to the subfamily.

It may be useful to note that at the commencement of his work Sir George gave a table of fifty-two families of Lepidoptera, of which seven (families 33–39 inclusive) are butterflies, placed between family 32, Castiniadæ, and family 40, Euschemonidæ, the remaining forty-five families being moths. Of these, the first three, the Syntomidæ, Arctiadæ, and Agaristidæ, are described in the three first volumes of the work; while of the fifteen subfamilies into which the Noctuidæ are divided at the commencement of vol. iv., only the first four subfamilies have yet been dealt with. It therefore follows that the nine volumes which have hitherto appeared cannot be expected to represent a quarter, and perhaps not even a tenth, of the whole work, although

many of the families of moths and the subfamilies of Noctuidæ still to be monographed are undoubtedly much less numerous in species than those already described.

When we consider how very few species of insects were known to entomologists a century, or half, or even a quarter of a century ago, the enormous increase in our knowledge of this subject within the last few years is simply marvellous, even to those who have witnessed, and to some extent kept touch with, its progress from day to day.

Report on the Poultry Industry in Belgium. By Edward Brown. Pp. viii+112. (London: National Poultry Organization Society, Ltd., 1910.) Price 1s. net.

In 1906 and 1907 Mr. Brown visited America, Denmark, and Sweden to inquire into the methods followed in the poultry industry, and during last year he visited Belgium with a similar object. Probably in no country in the world is intense production more general than in Belgium, one consequence being that it supplies its own poultry and egg requirements, and is not dependent, like England, on imports from foreign countries; indeed, it has a surplus for export.

Although in some respects the conditions in Belgium resemble those obtaining in England, there is the fundamental difference that the Belgian farmer specialises in small animals, like poultry, rabbits, even in pigeons and cage-birds as a hobby, whilst the English farmer has gone in for larger stock. Poultry-farming pure and simple is not common. But everywhere Mr. Brown found that poultry figured as an adjunct to the farm, particularly on the small holdings. In some cases, indeed, land did not come under cultivation until it had been run over for some years by fowls, and fertilised by their droppings. Thus the Campine district, which extends from Malines east and north to the Dutch frontier, was at one time merely a sandy plain covered with fir trees. About thirty years ago the peasants began to raise chickens for sale to the fatteners; the industry spread, and now the trees are gone and the whole district is farmed. It would be interesting to know how many tons of purchased food were consumed per acre in effecting this change. Egg-production is stated to be the main object, and the birds are looked after by the women and children; the methods are, however, essentially simple, no more elaborate appliance being used than is absolutely essential.

The report contains a number of useful details, and concludes with a number of recommendations. The small holder in particular is urged to devote some, though not all, of his attention to poultry, and it is suggested that poultry-keeping should be encouraged on land at present waste. Various methods of management are also recommended.

Halley's Comet: its History, with that of other noted Comets, and other Astronomical Phenomena, Superstitions, &c. By Rev. John Brown. Pp. 52; illustrated. (London: Elliot Stock, 1910.) Price 1s. net.

As a useful collection of facts and references concerning Halley's comet this small volume will take a place in the mass of comet literature now appearing so profusely. It contains nothing startlingly novel, being, to a great extent, a compilation of interesting oddments gathered, with due acknowledgments, from various sources. In many places extraneous material is introduced, rendering the book perhaps more interesting, but less suitable as a precise account of what it presumes to deal with. The four illustrations are rather crude and of no especial interest.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Orientation of Crystals of Ice in a Flux of Heat.

It was found by Forbes many years ago that the thermal conductivity of ice was better along the principal axis than at right angles to it. Straneo, in 1897, does not come to any definite conclusion in deciding that such is the case. It is well known, however, that the formation of surface ice by conduction always shows the principal axis of the crystals to be normal to the freezing plane, or, in other words, in the direction of the flux of heat from the underwater. Since ice is a better conductor of heat than water, it is to be expected that if any difference exists in the conductivity in the two directions, the ice crystal would form in such a way as to dissipate the heat more readily.

During the process of the formation of an ice mantle in a rather large Bunsen ice calorimeter, my assistant, Mr. F. H. Day, directed my attention to a rather interesting case, which, I think, proves the better conduction along the axis of the crystal. The bulb of the calorimeter was about two-thirds immersed in a freezing-point mixture. This particular calorimeter was unusually difficult to start, and always refused to freeze when ether was rapidly evaporated in it, or when a saline ice mixture was introduced. In consequence, our custom has been to add some liquid air or solid carbon dioxide, as most convenient at the time. In this case we used solid carbon dioxide. The undercooling must have been considerable around the inner glass tube, and a sharp temperature gradient resulted between the lower part of the glass and the walls of the calorimeter. Heat was flowing in from the freezing-point mixture, but near the surface the heat flowed in more rapidly around the exposed portion of the bulb. The ice formed as usual, but on withdrawing the calorimeter for inspection we found, growing out from the solid mantle of ice, long needles and thin plates, which were perfectly orientated along the lines of the flow of heat. The crystals near the top of the mantle were directed at an angle upwards, while those at the base were found normal to the mantle surface. Between these positions the crystals grew at a corresponding inclination to the mantle surface. This, I think, conclusively shows the path of best conductivity in the ice crystal to be along the principal axis.

H. T. BARNES.

McGill University, April 19.

Zeeman Effect of the Yellow Mercury Line λ 5770.

It is well known that the separation of the mercury line λ 5770 in a magnetic field into a triplet is abnormal, inasmuch as the value of the ratio e/m of vibrating electrons is much greater than that obtained from experiments on kathode rays or from measurements of the Zeeman effect on other lines of mercury and of other elements. Lohmann first noticed that the line is separated into a nonet in strong fields, but did not investigate its type. By using an echelon spectroscope of resolving power 430,000 for $\lambda = 0{\cdot}5\mu$, I found that the distribution of lines in the nonet can be accurately examined by using a vacuum tube of special construction. From a field of 18,000 gauss upward, the lines composing the nonet were distinctly observed with my instrument. They are distributed in three groups of three lines each, closely arranged at equal intervals, and each group occupies the position of the normal triplet. No dissymmetry with respect to the middle line was noticed. Several measurements in fields between 18,000 and 28,000 showed that the separation of lines in each group is proportional to the field strength, so that in weak fields each group appears as a single line. The lines of the middle group are equally bright, but the intensity of the remaining two groups of lines diminishes as we proceed outwards, just as is the case with the mercury line 5461, which is also divided into

a nonet. Runge's law is applicable to 5770; the type of the nonet is such that the lines form aliquot parts of $a = e/m.H/4\pi$, and the difference in the number of vibrations of these lines can be represented by

$$0, \pm\frac{a}{8}, \pm\frac{8}{8}a, \pm\frac{9}{8}a, \pm\frac{10}{8}a.$$

Considered as a triplet, which corresponds to lines 0, $\pm\frac{9}{8}a$, Gmelin found that $e/m = 2{\cdot}02 \times 10^7$; v. Baeyer and Gehrcke obtained $2{\cdot}06 \times 10^7$, which is also the number I have arrived at from the same standpoint. Considered as a nonet, however, we have to multiply the above number by $\frac{8}{9}$, so that the corrected result turns out to be:—

Gmelin	$1{\cdot}80 \times 10^7$
Gehrcke and v. Baeyer	$1{\cdot}83 \times 10^7$
Nagaoka	$1{\cdot}83 \times 10^7$

This is in close agreement with the same constant obtained from measurements on the nonet of the mercury line 5461, for which $e/m = 1{\cdot}80 \times 10^7$.

The above examination of the line 5770 shows how the different types of a class of nonets are derived from normal triplets.

Starting from the normal triplet A, we get nonets of types B, C, and D by doubling the intervals of component

FIG. 1.

lines of each group, as shown in Fig. 1. Considered as aliquot parts of a, they are represented by

$$\text{B.} \quad 0, \pm\frac{a}{8}, \pm\frac{8}{8}a, \pm\frac{9}{8}a, \pm\frac{10}{8}a.$$

$$\text{C.} \quad 0, \pm\frac{a}{4}, \pm\frac{4}{4}a, \pm\frac{5}{4}a, \pm\frac{6}{4}a.$$

$$\text{D.} \quad 0, \pm\frac{a}{2}, \pm\frac{2}{2}a, \pm\frac{3}{2}a, \pm\frac{4}{2}a,$$

with direction of electric force as shown in the figure, p indicating that it is parallel, and s at right angles, to the direction of the field. B is represented by the line 5770, C by the neon lines 6678 and 6305, and D by the mercury line 5461. Probably there is also a type

$$0, \pm\frac{a}{16}, \pm\frac{16}{16}a, \pm\frac{17}{16}a, \pm\frac{18}{16}a,$$

intermediate between A and B. Of the different lines which I have examined, the copper line 5105 seems to belong to this type, but as it requires high resolving power I have not been able to clear up this point. It appears to me quite probable that triplets, which show broadening of lines and no asymmetry in high fields, and give values of e/m greater than $1{\cdot}87 \times 10^7$, belong to some of the intermediate types.

H. NAGAOKA.

Physical Institute, University of Tokyo, March 29.

The Fertilising Influence of Sunlight.

IN NATURE of February 17 is a communication from Mr. and Mrs. Howard pointing out that the probable explanation of the advantage of leaving land rough ploughed during the hot weather in India is that the biological changes which occurred under the conditions of Messrs. Russell and Hutchinson's experiments occur here also.

The following temperature record, which is one of the highest I have, will be of interest in this relation:—

Date, May 28, 1906.

Maximum shade temperature	107° F.	...	42° C.
Maximum temperature of soil 3 in. deep	109	...	43
,, ,, ,, 6 ,,	109	...	43
,, ,, ,, 9 ,,	104	...	40
,, ,, ,, 12 ,,	100	...	38
,, ,, ,, 24 ,,	93	...	34

Other records of soil temperature in Behar are published in "An Account of the Research Work in Indigo at Dalsing Serai, 1903–4," by Bloxam, Leake and Finlow (Appendix ii.). Temperatures approximating to 50° C. at 1 inch from the surface were recorded.

The hot-weather temperature here (Behar) is not so high as in some other parts. Jacobabad "enjoys" one which runs up to 127° F. on occasions, and the whole of the western part of the Punjab (an area equal to about twice that of the British Isles) is liable to maximum air temperatures of 110°–115° F. (43°–46° C.), so that the surface soil in that part may be assumed to attain an average temperature some 10° F. (5° C.) higher than here at Pusa; but it is certain that, however uncomfortably hot India is, its soils never attain a temperature anything approaching 100° C.

Dr. Russell mentions (NATURE, March 3) that biological changes at temperatures below 100° C. are being studied, so that we shall doubtless learn shortly in how far they assimilate under these conditions to the effect at 100° C. In any case, it must not be forgotten that there cannot be much difference in temperature between roughly ploughed land and unploughed land which has carried a cold-weather crop; in both the amount of moisture in the first 6 inches will be nominal, and the thermal capacity of each must be much about the same. The roughly ploughed soil will include more air, and I should expect the rise of temperature at 6 inches to be rather greater in unploughed land. Hence if this agricultural practice is found to be accompanied by important biological changes, this must be due to some cause other than mere temperature.

Regarding the effect of *sunlight*, this can only affect the outside surface; in unploughed land this is better defined than in broken-up land, and during the ploughing operation more soil is exposed (temporarily) to the sun than in the former case, but the ploughing here referred to is commonly *one* ploughing, not a "multiple stirring" such as occurs in the preparation of the seed bed.

Finally, it is perhaps unnecessary to mention that this rough ploughing results in other advantages than those mentioned. One is that the soil absorbs more of the first monsoon rain than unploughed land, and can be prepared for monsoon crops much more quickly.

Pusa, April 13. J. WALTER LEATHER.

Observations of Halley's Comet.

I SAW Halley's comet through field-glasses on Sunday morning, April 24, at 3.40. It was then about 10° above the horizon, 20° to the left of Venus, and slightly under it. It was very distinct from 4.0 to 4.20. At its best, 4.15, I could just distinguish the head by the naked eye, but only for a minute.

The tail appeared broad and short, only about twice the moon's apparent diameter in length, with its axis at 40° to the horizon. The tail began to grow indistinct at 4.30, but the head was visible to 4.45.

The sky was not ideal, Pegasus not distinct, Cassiopeia only partially seen, but Venus was very distinct and bright.

I saw the comet again yesterday—Monday, April 25—from 4.0 to 4.15. The sky was not at all clear. The comet was in a line with Venus, and still about 20° to the left. I could not see it with the naked eye.

This morning, April 26, comet was clearly seen from 3.45 to 4.30. The tail appeared longer and more elegant in appearance. It was perhaps 5° above Venus, and less than 20° to the left. The head was easily seen at intervals by the naked eye, but the tail showed only a trace, and that only once.

The measurements are only by the eye, but are, I think, fairly correct. C. LEACH.

Malta, April 26.

Anomalous Reading of Hygrometer.

MR. RICHARDSON's explanation in NATURE of April 28 of the anomalous readings referred to does not seem very satisfactory, because, owing to the presence of dust in the atmosphere, the air is never supersaturated; indeed, it is seldom even saturated, owing to the presence of some particles having an affinity for water vapour. But even supposing there had been supersaturated air at the time, then the "dry bulb" would also form a condensing surface and would have been heated as well as the wet bulb. Fortunately, the observer of the anomalous reading noted that the temperature was rapidly falling at the time, and the bad conducting covering of muslin would quite account for the wet bulb falling slower, and so reading higher than the dry.

J. A.

THE LONDON TO MANCHESTER FLIGHT.

THE success of M. Paulhan in reaching Manchester from London by aëroplane, and thus gaining the *Daily Mail* prize of 10,000*l.*, for which Mr. Grahame-White had made such a valiant struggle, is the second case in which an English aviator has been within measurable reach of a success which has actually been achieved by a Frenchman. Last summer it was Latham who attempted and failed to cross the Channel, and Blériot who carried off the palm.

The success of the present effort affords a striking measure of the rapid progress that has been made within the last three years in extending the performances of aëroplanes. When first the offer of the prize for the Manchester flight was announced it certainly looked as if a more useful purpose would be served by offering a prize to anyone who could fly at all. It is hardly likely that if the only inducements offered to aviators had been prizes for such long distance flights as the present one, the same amount of attention would have been devoted to short flights; but numerous private individuals, notably in France, filled up the gap by offering a large number of smaller prizes for more modest achievements, and, as soon as a flight of a hundred yards had been performed, the main difficulty of performing a flight of a hundred miles was overcome. All that remained necessary was experience, and such increase in the carrying capacity of aëroplanes as was necessary to provide an adequate supply of energy for the journey.

Owing to the fact that both aviators used Farman biplanes, the results do not teach us anything regarding the relative merits of different types of machine; and it would be premature to draw any inferences regarding the relative merits of "monoplanes" and "biplanes," in view of Blériot's monoplane success last summer. The Farman biplane, like most other aëroplanes, is probably longitudinally stable and laterally unstable, and in a short trial which Mr. Grahame-White made early in the afternoon before starting, the machine is described as swaying from side to side dangerously. In this respect, both competitors had the same difficulties to contend against, and in view of the fact that Mr. Grahame-White is a proficient flyer both on the Farman biplane and on the Blériot monoplane, and that he made a good sixty-five-minutes flight on the Farman machine, it is probable that under reasonable weather conditions the contest would have resulted in a tie. Mr. Grahame-White's failure was certainly attributable to the bad weather. He only started from London at 6.29 p.m. on learning that Paulhan had started an hour before, and thus he was only able to get that night to Roade, about the time when M. Paulhan descended at Lichfield, fifty-seven miles in front.

On the following morning chances were again against the English competitor, for, after struggling against the wind, he was "twisted from side to side and progress seemed impossible, so he decided reluctantly to come down"; four minutes after Paulhan had again started and only ten miles behind him. If the result proves anything, it is that the French aviator was either more skilled in checking the lateral oscillations of his machine in a high wind, or that his greater experience of meteorological conditions enabled him to seize opportunities which Mr. Grahame-White missed. Possibly, too, the difference of altitude may have affected the conditions, for, according to all chronicles, M. Paulhan seems to have flown higher than Mr. Grahame-White. At any rate, Mr. Grahame-White was at a disadvantage, for he started off without waiting for a meal on the first day, after hearing of M. Paulhan's start, and was probably less fit for his task the next morning. Whatever the explanation, however, it is abundantly shown that the time has not yet come when aëroplanes can be generally used for touring or for regular purposes of transport, but that much practical experience and fair weather are still required before a successful flight can be relied on. It is, indeed, a matter of congratulation that the landings were all effected in safety, and that neither Mr. Grahame-White nor M. Paulhan had any misfortunes of a serious character. At the same time, M. Paulhan is reported to have stated that he would not repeat the experience for double the prize, adding:—

"People fancy that because I did the flight well within the time it was all plain sailing. I can assure them that from the time I left Crewe the strain and anxiety with my machine was a tremendous burden, and when I put on speed and came within sight of Manchester I felt a perfect rag, wondering all the time if I could ever reach my goal. I don't believe, now that it is all over, that I could have kept it up a quarter of a mile further."

M. Paulhan has well earned his prize; but it is sincerely to be hoped that those who have money to give away in the future, and wish to promote the development of aviation, will devote it to competitions which are less strenuous tests of physical endurance, and more rigorous tests of the development of real advances in the construction of aëroplanes. The Aërial League's appeals in this direction have not met with too generous a response from the British public.

The use of the Gnome motor in these flights clearly demonstrates that the rotating-cylinder type of engine has a future before it. It obviates the vibrations necessarily associated with reciprocating engines, and affords a simple means of cooling the cylinders. The principle is old enough, and mathematicians have long puzzled over how to apply it, but the practical difficulties appear not to have been overcome until quite recently.

The flight has not been without its lessons regarding the means of finding one's way in the air. In this case the London and North-Western line was followed, the course being indicated by whitening the sleepers in places, and the possible halting places also being clearly marked.

If one success has thus been scored in April, the *Deutsche Zeitschrift für Luftschiffahrt*, on the other hand, describes April as the black month for aërial navigation, and April 3 as the *Dies irae*. In the issue for April 20 are portraits of Prof. Abegg, Dr. Delbruck, and Herr Benduhn, victims of the accidents to the balloons *Schlesien* and *Pommern*, both of which sailed on that day; next we have Dr. Alberti's accident with a Blériot machine in Munich, Le Blon's death at St. Sebastian, Molon's misfortune at Cannes, Grade's accident at Leipzig—all chronicled or figured in this single number of the journal. In view of this series of misfortunes, we again express the hope

that future friends of aviation will discover means for advancing its development that will not tempt men to repeat such dangerous adventures as were inevitably associated with the London to Manchester flight, and that M. Paulhan's success will not stimulate a number of less experienced followers to attempt to emulate his achievement. G. H. BRYAN.

THE FIGHT AGAINST SLEEPING SICKNESS.[1]

(1) THE report of the German Sleeping Sickness Commission is an attractive work in which even those who are not specially concerned with the problems of sleeping sickness may find much to interest them. In addition to a great mass of detail bearing on the etiology, diagnosis, treatment, and prevention of a disease which is at present the most important economic problem of European administrations in Africa, the work contains many facts and observations of interest to the naturalist and the anthropologist, and is illustrated by numerous exquisite photographs. A certain number of the illustrations have, as might be expected in a work of this kind, a melancholy interest, representing the ravages of the disease as shown by sufferers from it, or even more significantly by deserted homesteads; but others give a vivid idea of the scenery of the shores of the Victoria Nyanza and of the dwellings, habits, and appearance of the natives of that region.

After a brief introduction and an account of the general course of the expedition, by Dr. Koch, there follow sections on the etiology of sleeping sickness, by Dr. Koch; on diagnosis and on clinical observations, by Prof. Beck; on the treatment of the disease, by Prof. Beck and Prof. Kleine; and on preventive measures, by all three authors. In an appendix are to be found meteorological observations made during the expedition, and a history of 180 cases of sleeping sickness that came under observation and treatment, with their temperature charts.

The section on etiology is divided into two parts, dealing respectively with *Trypanosoma gambiense* and *Glossina palpalis*. Trypanosomes were found not infrequently in the blood of persons whose glands did not show the characteristic swellings and who presented no symptoms of disease. The number of trypanosomes in the blood of infected persons was always small, and appeared to be subject to periodic variations. In the lymphatic glands trypanosomes were more numerous than in the blood. It is stated that the trypanosomes in the blood were always uniform in appearance, and showed no differentiation of form; but all preparations seem to have been made by methods which, though suitable for clinical diagnosis, were quite inadequate for accurate study of structural details.

Many animals were examined with the object of discovering a vertebrate host other than man for *Trypanosoma gambiense*. Of mammals, only in a single monkey were trypanosomes found, similar in type to *T. gambiense*; those found in birds, on the other hand, were of a distinct type. In reptiles, trypanosomes were found in tortoises and crocodiles. The trypanosome of the crocodile is described as large, and similar in appearance to the European *T. rotatorium* of frogs. In view of the erroneous statements that have been so often made, attributing to Dr. Koch the discovery of a connection between sleeping sickness and crocodiles (see NATURE, February 18, 1909, p. 458), attention should be directed to his clear statement that "in any case there is no connection between this crocodile-trypanosome and *Trypanosoma gambiense*."

With regard to the transmission of *T. gambiense*, Dr. Koch believes it to be effected by *Glossina palpalis* alone. Nearly three thousand tsetse-flies of this species were examined, and 189 of them were found to contain trypanosomes; of which four types are distinguished and described with the aid of coloured figures drawn from stained preparations. Three of these types of "wild" trypanosomes are considered to be distinct from *T. gambiense*, with which species, however, "Type IV." is identified; it was found five times in tsetses caught on the Sese Islands. "Type I.," the commonest of the four types in occurrence, is identified with the trypanosome of the crocodile. Attempts were made to infect tsetse-flies with *T. gambiense* by feeding them on infected animals, but in all cases the trypanosomes died out in a few days in the alimentary tract of the Glossina. The infection of the tsetse-fly can only be brought about, it is suggested, under certain definite but as yet unknown conditions. The more recent work of Prof. Kleine and Sir David Bruce will doubtless, when completed, make clear the nature of these conditions and solve a problem which has baffled previous investigators.

A number of observations upon the habits of *Glossina palpalis* are set forth. Dr. Koch is of opinion that crocodile-blood is the principal food of this fly, but that other animals also contribute to its nourishment, especially the hippopotamus. Experiments were made on the effects of clearing the vegetation in spots haunted by the fly, with results confirmatory of the experience of others, that this is an effective method of banishing the fly.

At the beginning of the section dealing with etiology in this report, Dr. Koch points out that the more important facts bearing upon this subject have already been made known by the work of others, and that consequently the investigations of the German Commission can only pretend to fill some gaps and contribute towards "completion of the etiology." It is doubtless for this reason that Dr. Koch so seldom mentions the results of other investigators in his account of his own observations, and often writes in a manner which might lead those unacquainted with previous work on the subject to think that his observations were new. As a matter of fact, the only discovery which can be claimed by Dr. Koch and his collaborators as entirely original, so far as the etiology of sleeping sickness is concerned, is that of the occurrence of trypanosomes in the salivary glands of the tsetse-fly. This important discovery, which was first announced in a preliminary communication to a German medical periodical in 1907, had not been made previously by any investigator, and was received at first with some scepticism, but has since been confirmed by Prof. Kleine and Sir David Bruce.

Prof. Beck's section on the diagnosis of sleeping sickness deals in turn with gland-puncture, lumbar puncture, and blood-investigation. The last of these methods is considered the surest when carried out in a manner which was employed by the Commission, and is described in detail; it is stated to have often given positive results when other indications were negative, especially in those cases in which the glands had become normal under treatment.

[1] (1) Bericht über die Tätigkeit der zur Erforschung der Schlafkrankheit im Jahre 1906–7 nach Ostafrika entsandten Kommission. Erstattet von Dr. R. Koch, Prof. Dr. M. Beck, and Prof. Dr. F. Kleine. Pp. vi + 320; 5 plates. (Berlin: Julius Springer, 1909.) Price 16.40 marks.

(2) Bibliography of Trypanosomiasis. Compiled by C. A. Thimm. Pp. iv+228. (London: Sleeping Sickness Bureau, Royal Society, 1909.) Price 4*s.*; to be obtained from the Bureau.

(3) Sleeping Sickness Bureau, Bulletin No. 13. Vol. ii., January. (London: Royal Society, 1910.)

(4) Report on the Measures adopted for the Suppression of Sleeping Sickness in Uganda. By Sir Hesketh Bell, K.C.M.G. Colonial Reports.—Miscellaneous, No. 65, December, 1909. Pp. 27, 1 map.

With regard to the treatment of sleeping sickness, Prof. Beck deals with the use and effects of atoxyl, and Prof. Kleine with those of other drugs, of which a variety were tried, but with results inferior to those yielded by atoxyl. For combating sleeping sickness Dr. Koch lays stress on the importance of discovering the infected persons in the earliest stages of the disease, both because curative treatment has then most chance of success, and also in order to prevent them from spreading the infection. The treatment should be carried out in concentration camps situated in places free from tsetse-flies. Healthy populations should be hindered from access to the lake-shore except at places cleared of the vegetation which shelters the tsetses, and the collection of rubber should be forbidden so long as there is danger of infection in the forests on the shore. The tsetse-flies should be kept in check by clearing vegetation in their haunts and by destroying the crocodiles, their principal food supply; this object is to be effected by encouraging the destruction of the nests and eggs of these reptiles. In view of the voracity of tsetse-flies and the readiness with which they suck the blood of any vertebrate animal, it may well be doubted whether the extirpation of crocodiles, though very desirable for many reasons, if practicable, would have the desired effect of diminishing the numbers of the flies to any appreciable extent.

(2) The bibliography of trypanosomiasis issued by the Sleeping Sickness Bureau is a labour-saving publication that will be most useful to those occupied with any problems, whether medical or scientific, relating to trypanosomes and their hosts, vertebrate or invertebrate. It aims at being complete up to March 31, 1909, and contains references, alphabetically arranged, to about 1900 original memoirs, articles, and treatises, catalogued under the authors' names, and numbered in order. In addition to these numbered references, the titles of journals that contain literature on trypanosomes or tsetse-flies are inserted without numbers, followed by a list of the articles or memoirs they contain, so that it is possible to look up the title of a journal in the catalogue and find what papers on trypanosomes or tsetses have been published in it. It is stated that a subject-index is in course of preparation, to be issued as a supplementary pamphlet, indicating the numbers in the bibliography to be consulted for the various subjects.

(3) The thirteenth Bulletin of the Sleeping Sickness Bureau begins a second volume of this most useful publication. Amongst other subjects, the present number deals with the transmission of trypanosomes, the treatment of trypanosome-infections, methods of destroying tsetse-flies, and the alleged occurrence of "ultra-microscopical" forms of trypanosomes. An interesting account is given of a method of destroying tsetse-flies, discovered by Mr. Maldonado, manager of an estate on the island of Principe, who observed that these flies attacked the backs of labourers stooping at their work in the fields; he caused the labourers to wear on their backs black cloths coated on the outer surface with a glutinous substance. In this way 133,778 tsetse-flies were trapped on one plantation during some twenty months. This method may be found useful, it is suggested, for keeping down *Glossina palpalis* in places where clearing is impracticable. A very useful feature of the Bulletin is a section entitled "Sleeping Sickness News," in which information is given concerning recent developments of the disease and measures taken to check it.

(4) Sir Hesketh Bell gives a historical account of the progress of discovery and research, and a summary of the results gained, with regard to sleeping sickness. He then describes the administrative measures taken in Uganda to combat the disease. These measures may be summarised as follows:—(1) The removal of infected persons into fly-free areas, that is to say, more than two miles away from the lake-shore, in order that they shall not render the tsetse-flies infective and capable of transmitting the disease to healthy persons; for this purpose segregation camps have been started in which those afflicted with the disease are put under medical treatment; (2) the removal of healthy persons from areas infested by tsetse-flies, until such time as the flies may be supposed to have lost their infectivity; (3) the extirpation or banishment of the fly, by clearing the forest on the foreshore of Lake Victoria, in those places, such as ferries or ports of main trade-routes, from which it is not practicable to remove the population. The task of keeping the foreshore clear is stated to have been aided greatly by planting the cleared areas with citronella-grass, which grows rapidly, and is also of commercial value, yielding a considerable amount of valuable oil.

These measures, when first planned, were based on the belief that the tsetse-fly only transmitted the disease mechanically and did not remain infective for a longer period than forty-eight hours, a belief founded on the experimental results of scientific investigations which had at that time demonstrated clearly the existence of so-called "direct" or "mechanical" infection, but had failed to obtain evidence for the occurrence of deferred or "cyclical" transmission. Consequently it was thought that the flies would lose their infectivity very quickly when they could no longer suck the blood of diseased persons. The recent researches of Kleine and Bruce, however, have shown that the trypanosome of sleeping sickness goes through a developmental cycle in the tsetse-fly, and that when once the trypanosome has established itself, the fly remains infective, apparently for the rest of its life, without again feeding on the blood of an infected person. It follows from this discovery that the period for which healthy persons must be removed from the fly-belts, in order to ensure that the infection has died out in the flies, is much longer than was thought, and cannot at present be stated definitely. There are two further possibilities to be borne in mind, neither of which have as yet been proved, though often suspected, to exist, and which greatly complicate the problem of the transmission and spread of the disease. One is that an infected tsetse-fly may transmit the infection to its offspring; the other, that some vertebrate animal other than man may harbour the trypanosome of sleeping sickness in its blood, and so be a "reservoir-host" which keeps up the infection in the flies. It must also be remembered that to keep the natives, probably much against their inclinations in many cases, more than two miles from the shore along the immense coast-line of the Victoria Nyanza must be a task of considerable difficulty and of uncertain result. The natives concerned are evicted from the homes which they and their ancestors have inhabited for untold generations, and, moreover, they are for the most part extremely sceptical as to the agency of the tsetse-fly in the transmission of the disease. It is therefore extremely probable that in spite of administrative prohibitions, leakage, so to speak, sometimes occurs, and natives evade the regulations against frequenting the danger zone. In a recent communication to the Royal Society (*vide* Proceedings, 1909) Bruce and his collaborators state that they have found tsetse-flies still infective that were caught in localities from which the natives had been removed, and conclude that the tsetse-flies "can retain their

infectivity for a period of at least two years after the native population has been removed." Whether this very discouraging result is to be explained by longevity of the flies, by hereditary transmission of the trypanosomes in the flies, by the existence of "reservoir" hosts, or by leakage and transgression of official orders, cannot be decided positively at present. Time alone can show if the measures adopted will be efficacious in stamping out the disease and the result will be awaited anxiously by all who have the interests of our African colonies at heart.

E. A. M.

DEVELOPMENT OF UNIVERSITY (AND OTHER) EDUCATION IN INDIA.

THE recent publication of the "Fifth Quinquennial Review of the Progress of Education in India, 1902–7," by Mr. H. W. Orange, C.I.E.,[1] Director General of Education in India, indicates clearly that very considerable and satisfactory progress is being made in India in all branches of education, and that the university standards in particular are being raised and made more real and effective. The review deals with the period 1902–7, and it is probable that during no previous five years has there ever been such rapid and sound progress.

The best indication of the increased amount of attention which education is securing will be found in the expenditure, which is mainly met from public funds. Thus in 1902 the total expenditure on education in India was 401 lakhs of rupees, while in 1907 it had advanced to 559 lakhs, or an increase of nearly 40 per cent. This increased expenditure has been accompanied by a very large increase in the number of pupils in all stages and branches of education. Thus there were nearly 1200 more pupils studying university courses, nearly 77,000 more secondary school pupils, and about 860,000 more primary school pupils under instruction in the year 1907 than there were five years previously. In certain cases much more progress was made in the five years, 1902–7, than had been made in the previous fifteen years. This is specially the case in the matter of training of teachers, in female education, in the special education of Mohammedans, and in the primary standards for boys generally, of whom, of course, the great majority are Hindus. These are all very healthy signs, and perhaps the first and second named may be considered as of almost vital importance to the satisfactory progress of Indian education and of India as a nation.

These great improvements have been mainly brought about by the fact that, under Lord Curzon's government as Viceroy, a general inquiry was held which extended to all kinds and grades of educational institutions, from the universities to the primary schools. This inquiry brought under examination the methods, organisation, tendencies, and results of Indian education as a whole, and resulted in the meeting of various committees, conferences, and commissions. As the result of these, certain general lines of policy were laid down by the Imperial Government, and these have since been continuously applied by the various local governments and authorities in meeting the local educational needs of the various provinces.

In the case of university education in India, a good deal of leeway had and still has to be made up. In many cases standards of teaching had become antiquated, and were also unsuitable. In previous years a great many art colleges had been started by persons wishing to help forward the great cause of education, and these had been affiliated to the various universities. Many of these were known to be insufficiently staffed and very imperfectly equipped generally, the main cause for such conditions being the exceedingly slender financial resources of these institutions. This has been due to their having no endowments and to the exceedingly small fees charged to the students, an annual fee of two to three pounds being commonly paid by a student for education up to B.A. and M.A. standards. Added to this, many colleges were endeavouring to teach a great variety of subjects instead of confining their attention to one or more simple courses, which could have been efficiently carried through with the means at their disposal. As a result of these conditions, a considerable proportion of the students sent up for examination had only received an imperfect training, and this state of affairs having gone on for a considerable period, it had almost insensibly reacted on the standards of the examinations themselves, which had become much lower than was desirable.

To remedy this state of affairs, after certain preliminary inquiries a University Commission was appointed which exhaustively examined into university education in all parts of India, and this reported in June, 1902. As a result a new Act was passed early in 1904 which reconstituted the five existing universities. Under the previous Acts of Incorporation the work of the universities was confined practically solely to the examination of students, while the new Act declared that the universities were "incorporated for the purpose (among others) of making provision for the instruction of students, with power to appoint university professors and lecturers, to hold and manage educational endowments, to erect, equip, and maintain university laboratories and museums, to make regulations relating to the maintenance and conduct of students, and to do all acts which . . . . lead to the promotion of study and research."

This contrast shows the different aspect in which Indian universities are now being regarded, and these provisions will probably gradually exercise a powerful influence, though from their nature their effect can only come slowly, but even now, in certain branches of study, university courses of lectures are being delivered.

Certain other provisions also appear in the new Act which even in the short time which has elapsed since it was passed are having important and far-reaching effects.

The senates were reconstituted, and steps were taken to make them more representative of those actually engaged in teaching in the affiliated colleges than had hitherto been the case, and appointments to the Senate were limited to five years instead of for life. These new senates are now working much more efficiently that was formerly the case. Under the Act also, new sets of regulations had to be prepared for all branches of study, and the Government of India was given the power, after consulting the Senate, to make such additions and alterations as might be considered necessary. Speaking generally of the new regulations, they are a very great improvement on the old ones, for they require a much higher standard of study, and also that such study shall be practical rather than of a theoretical nature. Indeed, in all the science subjects practical work is made an essential part of the course of study, whereas formerly theoretical book-work frequently sufficed to carry a student successfully through some of the science examinations.

Perhaps, however, the clauses of the Act which are having the most immediate and tangible effect are those dealing with the affiliation of colleges to the

[1] Published in Calcutta by the Superintendent of Government Printing in India, 1909.

various universities. Formerly, if a college was once affiliated, the university had practically no control of any kind over it, and though it might be known that a college was doing very inferior work, no effective remedial action could be taken. Under the new Act the connection between the college and university is much closer and more effective than it has hitherto been. The conditions which a college must fulfil in order to receive and retain the privileges of affiliation are prescribed in some detail in the Act, and in order that the university may be satisfied as to the fulfilment of these conditions, systematic and periodic inspection of colleges by university inspectors is established, and this is coupled with the power of calling upon a college so visited to amend within a specified period any points over the wide range of requirements laid down by the Act. These inspections took place almost immediately after the passing of the University Act, and it is not too much to say that the condition of affairs disclosed showed abundantly the absolute necessity of the action taken to secure the passing of the new Act. Some colleges, indeed, have already had, or will have, to disappear if they do not rise to the required standard within a reasonable time. In other colleges where defects were found, due mainly, perhaps, to want of funds, arrangements are being made to remedy them, and these efforts are being supplemented by annual grants of money made by Government, which grants are administered by the universities.

Another direction in which radical changes are taking place under the new Act and its consequent regulations is in the matter of the residence of students. Formerly, in many cases, these conditions were deplorable, but gradually a much better state of things is being evolved, and here again the change is largely due to improvements made with money given for building hostels, &c., by Government and by other donors.

That educational activity is increasing is also shown by the fact that at Allahabad in January of this year, the foundation stone of some important new university buildings was laid by Sir John Hewett, the Lieut.-Governor of the United Provinces, who is also Chancellor of the Allahabad University, and by a demand which is now coming from Burma for a new university to be established there, in addition to the existing universities at Calcutta, Bombay, Madras, Allahabad, and the Punjab. As time goes on, indeed, there will probably be room, not only for the Burma University, but for others at such places as Nagpore, in the Central Provinces, and perhaps at Aligarh, which is now the centre of a large and exceedingly well-managed Mohammedan college.

Such are the main lines on which the improvements in university education in India are being conducted, but the effect of the new University Act does not end here, and it has also had an important bearing on the schools for secondary education. In most Indian universities, students usually can only go up for the matriculation examination if they have studied at a high school recognised by the university. The standard set by the university matriculation, therefore, largely influences the secondary schools. Formerly these standards were low, and in many ways unsatisfactory, while the schools which had been "recognised" were many of them most inferior in every way, specially in teaching and discipline, and they could not possibly impart sound education or develop character. Now the standards for the matriculation examination have been revised and generally raised, while also the conditions under which the secondary schools receive recognition have been formulated under the various university regulations, and unless a school is shown by inspection to be satisfactory in respect of constitution, management, and financial stability, premises and equipment, staff, instruction, and discipline, it cannot be recognised by the university, and hence cannot send up its pupils for examination. Inspection, therefore, has to be made of schools as well as of colleges, and this is rapidly raising the tone of the education given.

Hence the new University Act of 1904 is having a very marked and beneficial effect on all forms of college and high-school education, and India appears to be entering on a more prosperous era in the matter of higher education in all its branches than has hitherto been possible.

THE NUTRITIVE VALUE OF BLACK BREAD.

DURING the last General Election much was heard about the hard lot of the German workmen and peasants who are compelled to eat black bread, and much political capital was made of it. It may therefore be interesting to inquire how much of a hardship this is from the point of view of nutritiousness and also of tastiness. The so-called black bread is made of rye, and has the property of keeping moist for a much longer time than wheaten bread, although if kept too long it is apt to turn sour. It is quite a mistake to suppose that it is nasty; in New York, where wheaten bread is the staple article of diet, the German bakeries almost always also sell black bread, even in the best quarters of the town, and it is said that black bread is always to be found on the Emperor's table. So those who habitually buy white bread by no means entirely discard the use of black bread, though it does not appear to have found very much favour except with those of German extraction.

From the various analyses which have been published, the amount of nitrogenous material contained in the different cereals does not differ greatly nor constantly; but wheat has its nitrogenous matter partly in the form of gluten, a sticky material almost wanting in the other cereals. So far, then, as nitrogenous constituents are concerned, everything turns upon whether gluten is more nutritious than the other nitrogenous bodies. There is no reason to suppose that it is, but its adhesive properties are valuable in causing the dough, when permeated by carbonic acid gas, as a result of fermentation, to rise into a more porous, spongy mass. The nitrogenous material contained in the flour of all cereals when it is made into dough commences to decompose, and in this state acts as a ferment, breaking up a portion of the starch into dextrin and glucose, whilst some part of the starch undergoes a further fermentation into alcohol and carbonic acid gas. In this state the dough is called "leaven," and small portions of it are capable of setting up the same action in much larger masses of dough.

This is the old way of preparing bread, and is still employed in the making of black bread; in the making of finer breads it is not wholly discarded, although yeast is used for the initiation of the process. If this change goes far the bread loses in whiteness, and the addition of alum as an adulterant is made with the view of checking the fermentation. It is not generally known that the comparatively dark colour of whole-meal bread is not due to the particles of bran which it contains, but to the fermentative changes having gone further. This is due to the husk containing another nitrogenous body, which also acts as an active ferment. In fact, in white bread a large proportion of the starch remains unchanged.

But whole-meal bread is well known to have a

higher nutritive value than white bread, probably partly on account of this conversion of the starch, which is a process indispensable to its digestion if it has not happened before it is eaten; and, of course, the whole-meal bread is richer in inorganic salts by the retention of the husk.

And it must not be supposed that rye bread is of necessity "black"; a bread that is lighter in colour than our brown bread can be made from rye flour, the depth of colour being dependent upon the treatment.

So far, then, there is not the smallest reason to suppose that black bread is inferior as a nutritive food to white bread, but rather the contrary.

Passing from the consideration of the nitrogenous (vegetable fibrin) constituents, rye contains as much or more starch and fatty matter as wheat. It contains more lime, about the same amount of magnesia, a good deal more silica, and slightly less phosphoric acid.

As the phosphates of lime and magnesia are needed for the calcification of bones and teeth, there is little to choose in this respect between a whole-meal wheaten bread and rye bread, both being superior to white bread. Formerly it was supposed that teeth of poor quality were actually deficient in lime salts, but this has been found not to be the case. Good teeth, whatever may be their chemical difference, and this has not been ascertained as yet, are unquestionably associated with good general nutrition in the growing person, and, of course, an adequate supply of lime and magnesia is essential to their formation. It should be added that the differences between samples of the same cereals are considerable, being apparently dependent upon the season, soil, and other conditions, so that in many cases the analyses show discrepant results.

But a consideration of the chemistry of the different breads gives no support to the idea that black bread is an inferior article of diet, and the German peasant is not to be pitied for having to use it. In texture it is moister, a little more sticky and doughy, does not get stale so soon, and it might not be wholly to the taste of those accustomed to wheaten bread, at all events at first. It is good food, nevertheless, and those accustomed to it often actually prefer it.

During the Crimean war the Russian prisoners in the hands of the French did not thrive, but after, on the advice of a Russian surgeon, they were given the black bread to which they were accustomed they did much better.

The political orator is not too particular about his facts so long as he thinks they will serve his turn, and the allegations made about black bread have been, to say the least, wanting in scientific accuracy, and so may be classed with much else that is heard from electioneering platforms as calculated, whether with intent or from ignorance, to convey a perfectly false impression.

COMMANDER PEARY'S EXPEDITION TO THE NORTH POLE.

NO geographical goal has been so long and ardently desired as the North Pole. The glamour of the Dark Continent, the mystery of the South Polar lands, the lure of Potosi and Golconda, have never touched the popular imagination like the attraction of the North Pole. The whale and seal hunters of the seventeenth and eighteenth centuries developed the art of Arctic travel; while the Eskimo, the polar fauna, and the heroism of the knights of the frozen seas, kept an undue share of popular geographical interest "North where the bergs careen." The commercial hopes that led to the search for the North-West Passage and the Franklin tragedy for a while made the Arctic Archipelago the centre of popular interest, but the North Pole, as a fixed spot, as definite as the winning post of a race, has kept its own as the goal most prized by sporting geographers.

It has at length been won, and the lecture by Commander Peary to the Royal Geographical Society, in the Albert Hall last night, told the story of the winning. The quest has been Commander Peary's one interest for twenty-four years; he has led four expeditions to reach the pole, after his remarkable exploration of the North Greenland ice-cap had given him the necessary experience, and had yielded him geographical results of perhaps greater scientific value than those of his last and most famous journey. He has carried through his work in an appropriately serious spirit. He has not regarded his quest as a mere matter of geographical athletics, but as a mission so important that he has been tempted to regard the Eskimo as placed by Providence in their inhospitable home on purpose to help him to his goal.

Commander Peary's lecture was a simple statement of the narrative of the expedition, and it gave no details as to the determination of the high latitudes, which geographers at this stage would have preferred to the short appendices giving the soundings and preliminary notes on the temperatures and tides. The expedition was apparently successful because a large force was able to start early in the season. Like Russia, according to Czar Nicholas, the pole has been protected by its ally, "General February"; but on this occasion the expedition began its journey from winter quarters in the middle of February. The party consisted of seven members, accompanied by seventeen Eskimos, 133 dogs, and nineteen sledges. With so large a staff a light advance party could be used to prepare the trail and successive divisions sent back from different stages, so that the final dash for the pole could be made by a party well equipped and comparatively fresh.

Commander Peary says that he and his comrades increased in fitness and training every day of the northern march. At a camp determined by Captain Bartlett as at 87° 48′ N., that gallant officer and the last supporting party returned, leaving Peary, his negro servant Henson, and three Eskimo, with forty of the best dogs and five sledges. On April 1 Peary continued northward, hoping to reach the pole by five marches of twenty-five geographical miles each. At the end of the fifth march a temporary break in the clouds at "approximately local noon, Columbia meridian," enabled Peary to determine the position as 89° 57′. A few hours later, with a light sledge carrying only instruments, drawn by a double team of dogs, he went on for another ten miles, and, as the sky cleared, he took observations, which showed that he had gone beyond the pole. After returning to camp he went eastward for eight miles, and both then and after his second return to camp he secured more observations, which confirmed his faith that he had reached and crossed the pole. Five miles from the pole he found a crack, and through a hole in it bored with a pickaxe he took a sounding of 1500 fathoms, and found no bottom. The expedition returned south by forced marches, and it reached Cape Columbia in such fine trim that it crossed to Cape Hecla, and thence to the ship, in two marches of forty-five miles each.

The only definite scientific contributions announced are the soundings, which indicated a depth of only 310 fathoms at 85° 23′; the depth had increased to more than 700 fathoms at ten miles further north, while at 87° 15′ the result was 1260 fathoms, with no

bottom. Further soundings were prevented by the loss of the wire, which broke on two occasions, detachable sinkers not having been employed.

The expedition gives convincing proof that the sea extends over the North Pole, confirming the view of the eighteenth-century whalers, who claimed to have occasionally found such open seas that they were able to attain high latitudes. So many British whalers claimed to have reached 82° and 83° in open water that it is difficult to disbelieve them all; and as the Greenland Sea was then being scoured by whalers, it is quite probable that they were occasionally able to attain these latitudes. The view that the sea extended to the pole was then partly based on the evidence of Dutch ships, that are said to have reached latitudes of 86°, 88°, and 89°; but the evidence for these latitudes was found unconvincing when it was discussed by Barrington in 1774.

Considering the exceptional interest in the achievement, and the impossibility of leaving any permanent record at the pole, Commander Peary's observations when published will, no doubt, be scanned critically, though in no hostile spirit. As Captain Bartlett accompanied him to 87° 48′—about 150 statute miles from the pole—and Peary thence made five long marches northward, there seems no reason why so expert an ice traveller, prepared to make the supreme effort of his life, should not have reached either the pole or sufficiently near it for all practical purposes.

As the great goal of Arctic enterprise has been won, we may now hope Arctic research will be continued in a more scientific spirit. There is much work still to be done. Geographically, the area now of most interest is that to the north-west of the Arctic Archipelago, and as Peary has shown that a large expedition can journey for four hundred miles out from land and back again, the search for the furthest islands of that group is possible by sledge journeys. The contour of the Arctic Ocean has still to be determined, and this work can hardly be done by sledge journeys, which can give but meagre results, compared with the work in a floating laboratory drifting, like the *Fram*, across the polar seas. Such work is slow, but the risks are probably not excessive. The Arctic death-rate has been far lower than the African, and, with the opportunities of life on a well-found ship, much of the biological and other scientific work might be done during the voyage. The reaching of the pole should change the methods but not lessen the interest of Arctic work.

Report and Conclusions on Peary's Arctic Work.

A full report of the speech delivered by the Hon. J. Hampton Moore, of Pennsylvania, in the U.S. House of Representatives on March 22, with reference to Commander Peary's work in Arctic regions and his attainment of the North Pole, has lately been issued. The subjoined extracts from this report will serve to supplement the information which Commander Peary was able to give in his lecture last night, and to substantiate his claims to distinguished eminence as a polar explorer.

Memorandum of Peary's Northern Voyages.

1886. May to November; about seven months: Penetrated 100 miles on the inland ice of Greenland east of Disco Bay, about 70° N. latitude; altitude, 7500 feet.

1891–2. June, 1891, to September, 1892; about sixteen months: Right leg broken on voyage north. Five-hundred-mile march out and same distance back, across northern part of Greenland, discovering Independence Bay on the north-eastern coast.

1893–5. July, 1893, to September, 1895; about twenty-seven months: Entire party except Peary and two men returned at end of first year. Spring of 1895 Peary repeated the march across northern end of Greenland, and gained some miles beyond his farthest of 1892. Discovered the great Cape York meteorites, and brought the two smaller ones back with him.

1896. July–October; about three months: Unsuccessful attempt to bring home largest of the Cape York meteorites.

1897. July–October; about three months: Brought home largest of the Cape York meteorites—the Ahnigito, the largest in the world—weighing about 90 tons.

1898–1902. July, 1898, to October, 1902; about four years, three and a half months: During this time made four separate attempts to get north, resulting in the rounding of the northern end of Greenland and the attainment of the latitude of 83·59° north of the extreme northern point of Greenland; also the attainment of the latitude of 84·17° north of the northern point of Grant Land. All the instruments, records, private papers of the Lady Franklin expedition at Fort Conger brought home.

1905–6. July, 1905, to November, 1906; about seventeen months: Highest north, 87° 6′, attained in this journey.

1908–9. July, 1908, to September, 1909; about fifteen months: Attainment of the Pole.

Summary.—Eight voyages, six attempts to reach the Pole, and some twelve years spent inside the Arctic Circle.

	Degrees N. Lat.		Degrees N. Lat.
1886	69·00	1900	83·59
1892	81·35	1902	84·17
1895	81·40	1906	87·60
1899	81·50	1909	90·00

Peary's ability as a commander is thoroughly demonstrated by the success of his various expeditions. Twice his ship was driven through the ice to the highest point ever reached in the western hemisphere, and to a point higher than any ship has ever attained under her own steam. Many other ships attempted this same voyage; four of them accomplished part of it, and two were lost. As to his work being civil and distinct from naval, it may be observed that Peary's bringing of the *Roosevelt* home in the autumn of 1906, fighting her way through the heavy Arctic ice, from Cape Union to Littleton Island, and thence down along the savage Baffin Land and Labrador coasts, encountering storm after storm, with rudder and sternposts torn away, propellers crippled, and pumps going constantly, has been characterised as one of the ablest, most resourceful, and courageous affairs of its kind in the annals of Arctic exploration. Indeed, it was the wonder of every-one who saw the ship when it was taken out on the dry dock.

With regard to the expedition that was successful, the expedition of 1908–9, resulting in the discovery of the Pole, he fitted out this expedition at his own expense and that of his friends, and was then granted leave of absence by the Navy Department, taking with him instructions which gave him an unqualified official connection with the Government.

Upon Commander Peary's return, the Navy Department asked the Coast and Geodetic Survey to furnish the results of the late expeditions carried on by him under the auspices of the Peary Arctic Club.

In reply to this request, Commander Peary sent a profile of soundings taken by the expedition, and tidal and meteorological records.

The following table shows the soundings from Cape Columbia to the Pole:—

Sounding by—	Latitude ° ′	Fathoms	Remarks.
	83 7	0	
Marvin	83 10	98	Edge of glacial fringe.
Marvin and MacMillan	83 25	96	
Bartlett	83 53	110	Edge of continental shelf.
Marvin	84 29	825	
Do...	84 39	580	
Do...	85 23	310	
Do...	85 33	700	No bottom.
Bartlett	87 15	1,260	Do.
Peary	89 55	1 500	Do.

Peary's Notes on Soundings.

The sounding equipment of the expedition consisted of two reels of specially made piano-wire of 1000 fathoms each, and three approximately 20-lb. leads, with clam-shell device for grasping samples of the bottom. These reels were arranged to be fitted quickly to the upstanders of a

sledge when making a sounding, and had handles for reeling in the wire and lead.

One of these reels and leads were carried by Bartlett with his advance party, and the other reel and two leads by the main party.

Portions of the wire and the two leads were lost at various times in hauling up, owing, probably, to kinks in the wire.

When the sounding at 85° 33′ was made, 700 fathoms only were left of the sounding wire of the main party, and Bartlett, with the other thousand fathoms, was in advance and inaccessible.

In hauling up the wire from this sounding it parted again, and some 200 fathoms, together with two pickaxe heads and a steel sledge shoe, which had been used to carry it down, were lost.

When Marvin turned back the Captain's 1000 fathoms and the remaining 500 fathoms of the other reel were combined.

When Bartlett made the sounding at 87° 15′ I gave him explicit instructions to use the utmost caution in regard to the wire, in order not to lose any more of it, as I wanted it all for a sounding at the Pole should I succeed in getting there.

Acting upon these instructions, Bartlett ran out 1260 fathoms and then stopped, on account of a small kink in the wire, which he feared would part when the wire was hauled up.

When I made my sounding about five miles from the Pole the wire parted, as had been feared, and the last lead and nearly all of the wire was lost.

The above facts are noted to explain the irregularity of these soundings, which did not get bottom.

The sounding of 310 fathoms at 85° 23′ naturally impressed me at once as surprising, and when Marvin reported the result to me, immediately after taking the sounding, I at once asked him if he was sure that he had the bottom, and he replied that he was, as the fact of this pronounced shoaling from 825 fathoms to 310 impressed him at once, and he made sure that his depth was correct.

Again, when the sounding of 700 fathoms and no bottom was made about ten miles farther north, we both spoke of the peculiar fact of this outlying ridge with deeper channel intervening between it and the continental shelf, and Marvin again said that he was sure of his 310 fathoms reading.

Had it not been for the loss of the last lead and practically all of the wire while making the soundings at the Pole, I should, on the return, have interpolated other soundings.

The profile indicates that a line of 5-mile interval soundings from Cape Columbia to the eighty-sixth parallel might develop a particularly interesting profile of the bottom of the Arctic Ocean.

Tidal Records.

The tidal records consist of practically unbroken series of hourly readings of the height of the tide, taken day and night, at the following places and between the dates specified :—

Station.	Period of observation.	Length of record.
		Days.
Cape Sheridan .	November 12, 1908, to June 30, 1909 (total loss of record, 31 hours) ...	231
Cape Columbia	November 16, 1908, to December 14, 1908	29
Cape Bryant ...	January 16, 1909, to February 13, 1909	28
Fort Conger ...	June 10, 1909, to June 25, 1909 (total loss of record, 5 hours)	10

The observations were taken day and night, and besides the regular hourly readings numerous additional readings were generally taken near the times of the high and the low waters.

Commander Peary's observations leave little to be desired in regard to tidal observations between Cape Morris Jesup and Cape Columbia; but there are long stretches of the Arctic coast where nothing is available. This is especially true of the Russian coast and the western and northern portions of the Arctic archipelago.

The results obtained from Commander Peary's records show that the tides along the northern coasts of Grant Land and Greenland are quite different in many respects from what had been heretofore supposed. For example, his records prove that the tide occurs three hours earlier at Cape Columbia than at Cape Sheridan, and not later, as had been generally assumed.

As already intimated, the full significance of these observations in respect to Arctic geography cannot be seen at this time.

The meteorological records consist of thermograms covering about 180 days, and barograms covering about 260 days.

National Geographic Society's Investigation.

At a meeting of the board of managers of the National Geographic Society, Wednesday morning, October 20, the records and observations and proof of Commander Robert E. Peary that he reached the Pole April 6, 1909, were submitted to the society.

The records and observations were immediately referred to the committee on research, with the direction that the chairman appoint a subcommittee of experts, of which he shall be a member, to examine said records and report on them to the board. Mr. Henry Gannett, chairman of the committee on research, immediately appointed as the other members of the committee Rear-Admiral Colby M. Chester, United States Navy, and O. H. Tittmann, superintendent of the United States Coast and Geodetic Survey.

In due course the board of managers of the National Geographic Society, at a meeting held at Hubbard Memorial Hall, Washington, D.C., November 4, 1909, received the following report :—

The subcommittee to which was referred the task of examining the records of Commander Peary in evidence of his having reached the North Pole beg to report that they have completed their task.

Commander Peary has submitted to this subcommittee his original journal and records of observations, together with all his instruments and apparatus and certain of the most important of the scientific results of his expedition. These have been carefully examined by your subcommittee, and they are unanimously of the opinion that Commander Peary reached the North Pole on April 6, 1909.

They also feel warranted in stating that the organisation, planning, and management of the expedition, its complete success, and its scientific results reflect the greatest credit on the ability of Commander Robert E. Peary, and render him worthy of the highest honours that the National Geographic Society can bestow upon him.

HENRY GANNETT.
C. M. CHESTER.
O. H. TITTMANN.

The foregoing report was unanimously approved.

Immediately after this action the following resolutions were unanimously adopted :—

"Whereas Commander Robert E. Peary has reached the North Pole, the goal sought for centuries; and

"Whereas this is the greatest geographical achievement that this society can have opportunity to honour: Therefore

"*Resolved*, That a special medal be awarded to Commander Peary."

Time Records on Dash to Pole.

Referring to the time occupied by Peary in his last dash to the Pole, Mr. Gilbert H. Grosvenor, director and editor of the National Geographic Society, says :—

"In view of the recent published statement by a Member of Congress doubting the distances travelled by Peary on his last northern sledge journey, I have gone to some trouble to obtain correct figures from the narrative of Peary's last and previous expeditions.

"Anyone who cares to take the time and trouble can verify these figures, and will find the following results :—

"Peary's average distance per march from Cape Columbia to where Bartlett turned back was 12·8 miles. Had it not been for the north wind two days, setting them back, this average would have been 13⅝ miles. Between two observations taken by Marvin the average of three marches was 16⅔ miles. Several of the marches were 20 miles.

"His average, from the time Bartlett left him, to the Pole was 26 miles. His average on his return was 25·6 miles.

"For comparison with the above figures, as showing that these averages are not at all excessive, the following facts can be taken from the narrative of the last expedition and previous ones:—

"Peary's last two marches on the return, from Cape Columbia to the *Roosevelt*, were 45 miles each. On this and previous expeditions the journey from Cape Hecla to the *Roosevelt*, a distance of 45 to 50 miles, was made in one march. The distance from Cape Columbia to Hecla was also made on other occasions in one march. The march from the *Roosevelt* to Porter Bay, a distance of 35 miles, was repeatedly made in eight, ten, and twelve hours. MacMillan and Borup, returning from Cape Morris Jesup to the *Roosevelt*, made the distance of 250 miles or more in eight marches, an average of over 31 miles a march. Peary, in one of his earlier expeditions, made the distance from Cape Wilkes to Cape D'Urville, a distance of 65 to 70 miles, in one march. He repeatedly made the march from Cape D'Urville to Cape Fraser, a distance of 40 miles, in one march, and in the winter of 1899–1900 travelled from Etah to a point in Robertson Bay, 60 miles distant, in less than twelve hours.

"On his return from Independence Bay to Bowdoin Bay, Peary averaged 20 miles a day for twenty-five successive marches; 210 miles in seven successive marches (an average of 30 miles a day), making the last march of 40 miles, all these with dogs not driven by Eskimo drivers.

"On more than one occasion in the fall of 1900 Peary's parties went from Lake Hazen to Fort Conger, both by the Bellows route and by the Black Vale route, distances either way of 50 miles overland, in one march. This after the sun had set for the winter.

"In February, 1899, before the sun returned, Peary (with both feet frozen six weeks before) sledged from Conger to Cape D'Urville, a distance of over 200 miles, in eleven marches, in an average temperature of $53\frac{1}{2}°$ below zero, an average of about 20 miles. In March of 1902 he went from Cape Sabine to Fort Conger, a distance of 250 miles to 300 miles, as travelled, in twelve marches, an average of 21 to 25 miles, and later covered the same distance again in eleven marches, an average of 22 to 27 miles.

"In the history of polar exploration no one has had so much and such long-continued training in ice work as Peary; his speed is the result of long years of practice, resulting in great physical endurance and skill in the use of the sledge."

NOTES.

ELSEWHERE in this issue Prof. Bryan deals with some aspects of the remarkable aëroplane flight from London to Manchester accomplished by M. Paulhan on April 27–28, thereby winning the prize of 10,000*l.* offered by the *Daily Mail* to the aviator who would make this cross-country flight within twenty-four hours. M. Paulhan left London (Hendon) at 5.22 p.m. on April 27, and descended at Lichfield—117 miles distant—at 8.10 p.m., that is, 2h. 48m. later. He left Lichfield at 4.10 a.m. on the following day, and arrived at Manchester at 5.30 a.m., the distance being 69 miles. The total distance covered with the one stop was thus 186 miles. The prize was presented to M. Paulhan at a luncheon given in his honour on Saturday, and a 100-guinea cup was handed to Mr. Grahame-White in recognition of his plucky endeavour to secure the prize for England. At the banquet, the editor of the *Daily Mail*, in expressing regret for the absence of Lord Northcliffe on account of illness, reminded the assembly that it was owing to Lord Northcliffe's personal initiative that the substantial prize won by M. Paulhan was offered for competition. He stated also that, in view of the great importance of aviation to Great Britain, the *Daily Mail* will immediately offer a further sum of 10,000*l.* for a flight of which the conditions will be announced shortly. Mr. Grahame-White, in acknowledging the toast of his health, said that it is his intention to expend the proceeds of the Royal Aëro Club's testimonial to himself upon the necessary organisation for an aëroplane flight from London to Paris "which I have made up my mind to attempt with the least possible delay." Though we have no sympathy with mere record-breaking, such flights as those accomplished across country by M. Paulhan and Mr. Grahame-White, and others now contemplated, provide practical demonstrations of aëroplane performances which will make the British people realise more than anything else the possibilities of aërial navigation. At present the man in the machine counts for everything; and an aëroplane which Prof. Bryan considers to be laterally unstable is so skilfully managed that it rises superior to its imperfections. It is indeed a sign of progress in the management of aëroplanes that, without a trial flight, and about nine hours after his machine arrived at Hendon, M. Paulhan should make a flight of 117 miles across country without a stop. No doubt much yet remains to be done before the best type of construction of aëroplanes can be determined; nevertheless, the flight last week will go down in history as a notable achievement.

IT is announced that Mr. P. H. Cowell, F.R.S., chief assistant in the Royal Observatory, Greenwich, has been appointed superintendent of the Nautical Almanac, in succession to Dr. A. M. W. Downing, who has retired.

WE have received with regret the announcement of the death, on April 28, of Prof. E. J. L. M. van Beneden, professor of zoology and comparative anatomy in the University of Liége, at sixty-four years of age.

A CONVERSAZIONE, with short lectures and lantern demonstrations, will be held by the Entomological Society in the rooms of the Civil Service Commission, Burlington Gardens, W., on the evening of Friday, May 27. Fellows of the society and others interested requiring further particulars are invited to address all inquiries to the honorary secretary, conversazione committee, 11 Chandos Street, Cavendish Square, W.

THE valuable collections of native African art made by Mr. E. Torday in the southern Belgian Congo are now being classified and arranged by the authorities of the British Museum. The most remarkable specimens in the collection are the wooden portrait statues of past rulers, which throw a new light on savage art in Africa. Next in importance are a splendid carved throne of the paramount chiefs, wooden caskets and cups, and specimens of remarkable textiles resembling velvet, made from the fibre of the upper skin of the palm leaf (*raphia*). This collection was happily made before the almost complete disappearance of native art work due to the importation of cheap European productions.

THE council of the Institution of Civil Engineers has made the following awards for papers during the session 1909–10:—a Telford gold medal to Mr. C. M. Jacobs (New York); a Watt gold medal to Mr. J. D. Watson (Birmingham); a George Stephenson gold medal to Mr. D. A. Matheson (Glasgow); Telford premiums to Messrs. F. C. Buscarlet (Sunderland), A. Hunter (Glasgow), I. C. Barling (Tynemouth), J. Dalziel and J. Sayers (Derby), and J. Shaw (Birkenhead); and the Manby premium to the late Mr. C. W. Hodson (London). The thanks of the council have been conveyed to their colleague, Dr. C. A. Harrison, for the paper contributed by him.

AT the annual general meeting of the Institution of Civil Engineers, held on Tuesday, April 26, the result of the ballot for the election of officers was declared as follows:—*President,* Mr. Alexander Siemens; *vice-presidents,* Dr. W. C. Unwin, Mr. R. Elliott-Cooper, Mr. A. G. Lyster, and Mr. C. A. Brereton; *others members of council,* Mr. J. A. F. Aspinall (Liverpool), Mr. B. Hall Blyth (Edinburgh), Mr. J. A. Brodie (Liverpool), Mr. W. B. Bryan, Colonel R. E. B. Crompton, C.B., Mr. Wm. Davidson (Australasia), Mr. E. B. Ellington, Mr. Maurice Fitzmaurice, C.M.G., Mr. J. P. Griffith (Ireland), Sir Robert A. Hadfield (Sheffield), Dr. C. A. Harrison (Newcastle-on-Tyne), Mr. W. Hunter, Mr. G. R. Jebb (Birmingham), Mr. H. E. Jones, Sir Wm. Thomas Lewis, Bart., K.C.V.O. (Aberdare), Mr. H. D. Lumsden (Canada), Sir Thomas Matthews, Hon. C. A. Parsons, C.B. (Wylam-on-Tyne), Mr. A. Ross, Mr. J. W. Shores, C.M.G. (South Africa), Mr. F. J. E. Spring, C.I.E. (India), Mr. J. Strain (Glasgow), Sir Frederick R. Upcott, K.C.V.O., C.S.I., Sir Philip Watts, K.C.B., Mr. W. B. Worthington (Derby), and Mr. A. F. Yarrow (Glasgow).

SCIENTIFIC work in America will benefit largely by the will of the late Prof. Alexander Agassiz. The American Academy of Arts and Sciences receives 10,000*l.*, and the National Academy of Sciences an equal sum. A bequest of 5000*l.* goes to the City of Newport, Rhode Island, for the support of the Coles Laboratory and for use in the maintenance of manual training in the city schools. The principal beneficiary is Harvard University. Prof. Agassiz has left to that institution a valuable collection of books and instruments, as well as a legacy of 20,000*l.* for the general uses of its Museum of Comparative Zoology. Another sum of 20,000*l.* is left to the president and fellows of Harvard for the publication of memoirs of Prof. Agassiz's own expeditions. In addition, a bequest of 2400*l.*, which is to provide a life income to two servants, is to revert to Harvard on the death of these servants and their wives, and the bulk of the estate, now to be divided among the three sons of the deceased, is also to become the property of the University should the family become extinct.

DR. C. B. PLOWRIGHT, whose death was announced in last week's NATURE, belonged to the school of mycologists founded by the Rev. M. J. Berkeley, one of the pioneers of modern mycology and the founder of plant pathology. Of this school only three members now remain, one of whom is the veteran Dr. M. C. Cooke. Among the members that assembled annually for the fungus foray, held under the auspices of the celebrated Woolhope Club, Dr. Plowright was always noted for his advanced ideas and his endeavours to elevate mycology from the old Friesian rut in which at the time it was firmly imbedded. His espousal of the heterœcismal theory of the rusts was the cause of much good-natured banter; nevertheless, Dr. Plowright commenced experiments and infections, which were continued for many years, and resulted in the production of the classic work entitled "A Monograph of the British Uredineæ and Ustilagineæ." A second publication of importance was "A Monograph of the British Hypomyces." In addition, more than one hundred papers bearing on systematic mycology and plant pathology have appeared under his name in various publications. He was a constant visitor to the various fungus forays for many years, and was for some time president of the British Mycological Society. His geniality and readiness to remove difficulties from amateur mycologists will doubtless be remembered by many, who will sincerely regret his removal from amongst them.

THE eleventh session of the International Geological Congress will be held in Stockholm on August 18–25, and the executive committee has prepared a very attractive programme both of meetings and excursions. The special problems of which discussion is invited are the classification of the pre-Cambrian system, post-Glacial climatic changes, the iron ore supplies of the world, the geology of the Polar regions, and the sudden appearance of the Cambrian fauna. The excursions are divided into three groups, those before, during, and after the congress. The most extensive of the preliminary excursions will be one to Spitsbergen under the conduct of Baron de Geer; it will last three weeks, and will be devoted to examination of the very varied glacial and stratigraphical geology of Ice Fiord. The cost of the excursion is 50*l.* Most of the other preliminary excursions are in northern Sweden, and include visits to the great overthrust area of Jämtland under the direction of Prof. Högbom, to the iron ore deposits of Lapland, to Lake Tornea to examine its overthrusting and Pleistocene geology, and to the peat deposits of Närke. There will be short excursions during the congress to localities easily accessible from Stockholm. Subsequently there will be excursions of from three to fifteen days to the chief localities of geological interest in southern Sweden, including the Archæan rocks of the south-western coast, the island of Gotland and other Silurian localities, the iron mines of middle Sweden, and the chief Mesozoic localities of Scania. The second session of the Agro-geological Conference will be held in Stockholm simultaneously, and though the two congresses are independent, geologists are invited to join both. In preparation for the discussion on the iron ore resources of the world, an elaborate collection of reports on the iron ore supplies of most countries has been collected from the geological surveys and mining geologists. It has been edited by the general secretary to the congress, Dr. Gunnar Andersson, and is being issued at a price of 3*l.* It consists of two quarto volumes of 1100 pages, with an atlas of forty-two maps and numerous plates. The work has not yet been issued, but from the list of contributions it is obviously a most valuable and authoritative statement as to the available supplies and distribution of iron ore.

THE weather was fairly normal over the British Islands during April, but the conditions were generally far less settled in the northern and western districts than elsewhere. Rain fell with considerable frequency, and at times the measurements were large, especially in those places where thunderstorms occurred. At Greenwich rain fell on seventeen days, yielding a total of 2·65 inches, which is 1·08 inches more than the average of the past sixty-five years; of this amount 1·50 inches fell on April 16, when a sharp thunderstorm was experienced. The mean temperature at Greenwich was 47·5°, which is 0·6° below the average, and there were only seven days with a temperature of 60° or above. Frost occurred in the screen on two nights, but radiation frosts occurred on sixteen nights, the exposed thermometer registering 15·9° on April 3. The sun was shining for 130 hours, which is seventeen hours less than the normal, and there were three days absolutely without sunshine. There were only three days during the month with the temperature in the sun's rays above 120°. In April last year the duration of bright sunshine was 250 hours, and there were twelve days with the solar radiation temperature above 120°, whilst the mean temperature was 49·6°, and the aggregate rainfall 1·64 inches.

IN vol. xxiv. of the *Queensland Geographical Journal* Mr. R. H. Mathews describes certain sacred stones used in burial and other rites by the aborigines of Australia.

One variety, known as Kopai balls, are made of burnt gypsum reduced to powder and moulded into a kind of concrete with ashes and sand. These are placed on the grave, and the spirit is supposed to come out and lick them, becoming in this way conciliated and friendly to the survivors. Another type of stone used in their secret rites is ground down into a blunt point at one end, and marks are cut on the surface with a sharp stone, shell, or piece of bone. The object of these markings is obscure, but they certainly convey some religious or symbolical meaning.

The Peabody Museum, Harvard University, continues in vol. iv., part iii., of its Proceedings for the current year the studies of the Maya Codices, of which two instalments have already appeared, with an attempt by Drs. Tozzer and Allen to identify the conventualised animal forms which appear in these remarkable documents. A detailed examination shows that only a small part of the animal life of the country occupied by the Maya-speaking peoples is represented, and while some drawings are fairly accurate, there is much difficulty in identifying other species which the artists intended to represent. Only those forms of animal life are depicted which possessed a mythological significance or were used as offerings to the numerous deities of the Pantheon. The whole scheme is thus purely religious, and the reproduction of this large series of animal figures will throw much light on the obscure religious system of this remarkable race.

Messrs. Dulau and Co. have issued in the series of "Eugenics Laboratory Memoirs" a memoir, by Mr. David Heron, Galton research fellow, on the influence of defective physique and unfavourable home environment on the intelligence of school children. The memoir is based on a limited survey of children in schools under the London County Council, carried on under the direction of the medical officer of the Education Committee, and the characters noted include the sex, age, height, weight, and condition of the teeth of the child, and, for certain schools, the state of nutrition, the condition of the clothing, the degree of cleanliness, the power of hearing, the condition of the cervical glands and of the tonsils, and adenoids. The methods used by Mr. Heron are in several respects novel and noteworthy, and the data based on the measured characters are of interest; but the memoir should serve its most useful purpose in indicating the absolute necessity for clear definition when qualitative characters are to be noted; the classification of the data in the present survey seems in several cases, owing to variations in the personal equation of the observers, to have been so unsatisfactory that little confidence can be placed in the results. So far as they go, these indicate but very slight correlation between intelligence and the other characters observed; but this result is in conflict with that given by the investigations of Dr. Francis Warner in 1888–91 and 1892–4, to which the author does not refer. Dr. Warner's surveys show a high correlation between dulness and malnutrition, and between dulness and development defects, and these conclusions seem the more probable.

According to the report for 1909, the Rugby School Natural History Society continues to maintain its record for good work, some of the papers being of a high character, while the illustrations of foreign Lepidoptera are beyond praise. Whether the system of annually making trips for the purpose of obtaining large series of the local Lepidoptera, illustrative of variation, and including as many varieties as can be obtained, is altogether desirable, we will leave our readers to decide for themselves.

"Records of the Western Australian Museum and Art Gallery" is the title of a new scientific journal started by the director of the museum at Perth, Western Australia. The first number is mainly devoted to an account of the so-called Mammoth Cave (a decidedly bad name for Australia), on the Margaret River, and its contained mammalian remains. Some of the latter are described by Mr. Glauert, and referred in part to existing and in part to extinct species of marsupials and monotremes.

We have received copies of the two volumes of the *Actes de la Société Helvétique des Sciences Naturelles* for the ninety-second session, 1909. Among the contents of the first volume is a summary of Dr. Fritz Sarasin's "Geschichte der Tierwelt von Ceylon," the full text of which we have received for review in another and later serial. In another article Dr. M. Bikli gives an illustrated account of the physiography and plant-life of Greenland, a country the name of which the author believes to be derived from the contrast between the barren coastline and the green carpet frequently clothing the slopes of the more inland fjords. A special feature of the country is, indeed, the abundant dwarf vegetation clothing almost all the elevated ground except the mountains, this being illustrated by a photograph taken a short distance inland on Disco Island, while other photographs show how this plant-growth has in the course of years covered boulders and slabs of rocks. A particularly interesting picture shows the rounded shores and islands of a typical glacier-landscape at the mouth of one of the fjords.

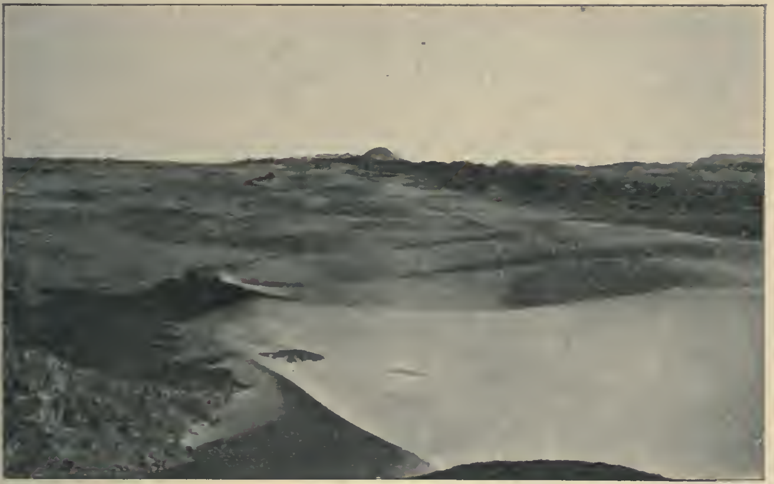
Discussing the action of light upon the green parts of plants in *Naturwissenschaftliche Wochenschrift* (April 3), Dr. Th. Löhr directs attention to the investigations of Senn upon the changes in form and position of the chromatophores. According to this observer, the green colouring matter occurs in the shape of drops or grains, the grana, invested by a distinct protoplasmic layer and lying in the general stroma of protoplasm. Under favourable conditions of light the chromatophores are polygonal, but when subjected to strong or weak light they contract to a globular form. Reference is also made to the hypothesis advanced by Stahl that the colour of the chromatophores is regulated so as to avoid absorption of heat rays and undue transpiration. The latter part of the article deals with the conclusions of Wiesner regarding the light requirements of plants, and Haberlandt's explanation of light perceptivity.

The second "Masters lecture" on the production of horticultural varieties was delivered by Prof. H. de Vries before the Royal Horticultural Society, and occupies the first place in the Journal (vol. xxxv., part iii.). He recognises varieties of two types, those which are constant at their first appearance and others which are continually sporting; the latter can only be fixed by "working up." As an example of his method, he relates his experience in trying to obtain the wholly peloric variety of *Linaria vulgaris*. For eight years he cultivated the ordinary species, treating it in various ways and excluding always the possibility of crossing with allied forms; during this period, inflorescences with occasional peloric (hemi-peloria) flowers were produced, and eventually plants producing all peloric flowers appeared in the cultures. He notes that seed was obtained from some of these wholly peloric flowers. In his book he states that the seed came only partially true, but by further cultivation and selection he reduced the "reverts" to a small percentage.

It has not been the custom to issue an annual report on insect pests in the West Indies, but a summary is pub-

lished in No. 201 of the *Agricultural News* of the more serious occurrences of pests during 1909. In only one district, a comparatively small area in Barbados, was any trouble experienced from the sugar-cane root-borer (*Diaprepes abbreviatus*); the larger moth-borer (*Castnia licus*) was, however, reported from British Guiana. The cotton-worm (*Aletia argillacea*), which was very abundant during the season 1908–9, has given very little trouble during the present season, nor have any other cotton pests been reported. Scale insects continue to attack limes, but no severe outbreak has occurred during the year; parasitic fungi are known to occur on these insects, and probably aid in keeping them in check. The scarabee, or jacobs, of the sweet potato (*Cryptorhynchus batatae*) has proved serious in Barbados, and cannot yet be controlled; new methods of treatment are therefore being devised. Another insect about which further information is required is a small moth, the larva of which lives in the heads of ripening sorghum, and causes much damage.

THE sand-dunes of the Libyan Desert have been studied by Mr. H. J. Ll. Beadnell during a residence of three years in Kharga oasis, some 300 miles south of Cairo (*Geographical Journal*, vol. xxxv., April, p. 379). Even where superposed on irregular sands, the dunes show a remarkable linear grouping from north to south. The dunes of Abu Moharik thus start west of Cairo, and thence form a belt 6 or 7 kilometres wide and 650 kilometres in length. The author traces the sand to the rocks of post-Middle-Eocene age that border the Mediterranean, and not to the Nubian Sandstone of the southern region. Between these two regions lies the tableland of Eocene limestone, grains from which may supply more than 7 per cent. of calcium carbonate to the dunes piled up in the oasis of Kharga. The growth and movement of crescentic dunes or barchans have been especially observed. By saturating the concave side of a barchan with water, it became possible to cut a section in it, showing a bedded structure formed by sand carried over from the windward side. Mr. Beadnell urges that this justifies the older view of the formation of the steep convex face, as against that of excavation by scour suggested by Dr. Cornish. Dr. Cornish, however, in the discussion on the paper, attributes the stratification to sliding following upon scour. Steep as the inner face seems to the eye, Mr. Beadnell shows that its slope cannot exceed 33°. The average rate of progression of dunes in the Libyan Desert, from north to south, is now for the first time measured over two years, and proves to be 15 or 16 metres a year. The finest material from the northern sandstones is probably recovered in the district of alluvial loams south of Kharga oasis.



A Belt of Dunes in Kharga Oasis, looking south or downstream. From the *Geographical Journal*.

IN connection with Prof. Silvanus P. Thompson's recent experiments on the physiological effects of an alternating magnetic field on the human body, Mr. A. A. C. Swinton, in a letter which appears in the *Electrician* for April 22, directs attention to several simpler methods of producing the same effects which have been known and used by medical men for some years. If the current from an ordinary magneto machine be passed from the hand to a wet sponge held on the temple behind the eye, a faint flicker will be seen, which increases in frequency as the speed of the machine is increased. If the current is sent through the head in other directions a metallic taste is produced in the mouth. By making the arms and body into the secondary of a coil of many turns carrying a high-frequency current, a small incandescent lamp the terminals of which are in contact with the two hands may be made to light up.

FROM a paper by Dr. L. A. Bauer in the March number of *Terrestrial Magnetism and Atmospheric Electricity*, it appears that a more detailed examination of the records of the magnetic storm which accompanied the eruption of Mont Pelée on May 8, 1902, has led him to the conclusion that the storm was not instantaneous over the whole earth, but that it originated about 14° west of Mont Pelée and travelled eastward with a velocity of about 7000 miles per minute round the entire globe. This result raised in Dr. Bauer's mind the further question whether magnetic storms in general are instantaneous over the whole earth, and an examination of the records of the disturbances of January 26, 1903, and of the seventeen cases tabulated by Mr. Ellis in his Royal Society paper, has led him to the further result that magnetic storms are not instantaneous over the whole earth, but in general travel to the east, occasionally to the west, with a speed of about 7000 miles per minute, which may be reduced considerably in the case of some of the larger and more complex disturbances.

MR. ARTHUR MORLEY contributes a useful article on the strength of materials under combined stresses in *Engineering* for April 29. Undoubtedly recent experiments on combined stresses have furnished interesting information on the behaviour of materials under static loads, but some hasty applications of this information are very unfortunate. A static determination of the tenacity of a material is easily made, and may serve as a useful index of quality, but it is well known that a simple stress of about one-quarter to one-third of this amount will be sufficient to cause fracture if frequently reversed in direction. What the conditions of failure may be under combined stresses which fluctuate are, in the absence of experimental evidence, at present unknown; but a safe load may as well be proportional to the static tenacity as to the static shear stress at elastic failure, and it is much too soon to speak of the entire revision of formulæ and practice affected by accepted theories, or to hope that controversy concerning the design of crank-shafts is ended. Rather it would be correct to say that only the fringe of the question has been touched.

A paper on the effects of sewage and sewage gases on Portland cement concrete was read at the Concrete Institute on April 21 by Mr. Sidney H. Chambers, surveyor to the Hampton Urban District Council, and appears in the *Builder* for April 30. Mr. Chambers has had special opportunities for studying this problem during the past five or six years, and has come to the conclusion that the gases in solution in sewage, and those expelled from it, arising from its decomposition, do act injuriously upon Portland cement concrete, even when the concrete is constituted of sound and good materials. However, little danger from erosion need be feared provided one or other of the following factors be absent :—(*a*) a high degree of putrescence of the sewage; (*b*) a moistened surface, which held or absorbed the putrid gases; (*c*) the presence of a free air supply. In one chamber under the author's observation, as the level of the liquid fell it left the concrete wetted with a liquid containing sulphuretted hydrogen in solution. This wet surface was then exposed to the action of the air supply, which oxidised the sulphuretted hydrogen with the production of sulphur and sulphuric acid, and led to the decomposition of the concrete, the lime being converted finally into sulphate of lime. The exact nature of the intermediate compounds cannot be stated, but it is probable that the active agent is sulphurous acid, as cement is insoluble in sulphuric acid. The decomposed concrete was washed away at the next rising of the liquid, thus exposing a fresh surface to the action. The continuation of this cycle led to the formation of grooves at the varying liquid-level.

Messrs. Swan Sonnenschein and Co. will publish in the course of the next fortnight a volume to be entitled "The Signs and Symbols of Primordial Man," in which Dr. Albert Churchward explains the evolution of religious doctrines from the eschatology of the ancient Egyptians.

A clearance catalogue of a miscellaneous collection of books, including works on America, Africa, &c., various domestic animals, and general natural history and literature, has just been issued by Messrs. John Wheldon and Co., Great Queen Street, Kingsway, W.C. The same firm announces the publication of a work, to be issued in twenty-five quarterly parts, on "South American Ornithology: a Manual of the Birds of Continental South America, from the Isthmus of Panama to the Straits of Magellan," edited by Mr. H. Kirke Swann.

MM. Gauthier-Villars, of Paris, have issued in their "Savants du Jour" series a monograph, by M. Ernest Lebon, dealing with Prof. Gaston Darboux and his work. The book opens with a biography of the distinguished mathematician and a list of the many distinctions conferred upon him. The remaining six sections are concerned with Prof. Darboux's contributions to mathematical science, and contain several appreciations of them by French men of science. It may be noted that Prof. Darboux's writings number 419. The volume, which costs 7 francs, contains an excellent portrait of Prof. Darboux.

We have received from Messrs. Newton and Co. an advance proof of the first portion of their new catalogue concerned with "Apps-Newton Induction Coils, X-Ray, High-frequency, Static, and other Electrical Apparatus for Medical Work." An introductory section, which precedes the price-list, provides the general medical practitioner with the information needed to enable a beginning to be made in the use of electrical methods in his practice. The catalogue serves, incidentally, to show with what powerful aids recent developments in electrical science have provided present-day physicians and surgeons. The contents of the list, arranged as they are so as to make reference easy, will prove of great interest, not only to medical men, but also to electricians.

Messrs. Kegan Paul, Trench, Trübner and Co., Ltd., have published an eighteenth edition of the late Mr. Winwood Reade's "The Martyrdom of Man." Reade, who died in 1875, in his thirty-sixth year, said of this book of his that in commencing it he intended "to prove that Negroland or Inner Africa is not cut off from the main-stream of events as writers of philosophical history have always maintained, but that it is connected, by means of Islam, with the lands of the East, and also that it has, by means of the slave trade, powerfully influenced the moral history of Europe, and the political history of the United States. But I was gradually led from the history of Africa into writing the history of the world."

OUR ASTRONOMICAL COLUMN.

Halley's Comet.—Attempts to observe Halley's comet, with binoculars or naked eye, during the past week have shown that it is by no means an easy object, especially for town-dwellers. By getting out of the town on its eastern side, thereby leaving the inevitable pall of smoky haze behind the observer, the chance of seeing the comet would be enhanced; otherwise the dawn becomes too bright ere the comet rises above the haze bordering the horizon. As shown in the following table, the conditions with regard to sunrise are now slightly more favourable, but the interval between comet-rise and sunrise again begins to decrease after May 6, and, on this account, observations will become increasingly difficult :—

	Comet rises a.m.	Sun rises a.m.
May 6	2.20	4.26
,, 9	2.19	4.21
,, 12	2.18	4.16
,, 15	2.37	4.11
,, 18	3.30	4.7

Despite the unfavourable conditions, several observers have reported seeing the comet with binoculars. Thus Mr. W. B. Tripp writes that he saw it plainly, from Isleworth, with a binocular field-glass, from 3.0 to 3.30 a.m. on May 3; to the naked eye it was a very faint object south of γ Pegasi. In addition to a bright nucleus, there appeared to be an appreciable, though short, tail, of which Mr. Tripp sends a rough sketch. Other naked-eye observations have also been recorded. Sir Robert Ball, telegraphing to the *Times* on May 3, said :—"Halley's comet was observed at Cambridge at 3 this morning. The stellar nucleus was between the second and third magnitude, and the tail was 20 minutes long."

The rapid approach to the earth should make observations easier, the distances, in millions of miles, for the next few days being as follows :—May 6, 56; May 10, 41; May 14, 27; May 18, 16; May 20, 14·3. After May 20 the comet will recede from us at about the same rate as it is now approaching us, attaining a distance of about 42 million miles on May 30.

Some interesting articles dealing with comets in general, and Halley's in particular, appear in No. 1926 of *La Nature* (April 23), which is wholly devoted to the subject. M. Jean Mascart discourses on the historical importance of Halley's comet; M. Rudaux discusses the nature of comets and their orbits, referring to many famous examples; and M. Touchet contributes a description of comet 1910*a*. All the articles are profusely illustrated with interesting diagrams and photographs.

Another interesting article, in which Dr. H. N. Russell discusses the conditions of the present apparition, is published in the *Scientific American* for April 16. He points out that the present apparition is a favourable one, and discusses the phenomena which may be observed. One of the illustrations is a reproduction of Prof. Frost's objective-prism spectrum of January 14, in which the cyanogen band is an outstanding feature. Dr. Russell makes some

interesting speculations as to the density of the comet, and suggests that golf balls, sown at the rate of two or three per cubic mile, would probably represent fairly well the degree of rarefaction obtaining in the head at the time its cross-section was 12,500 miles.

In No. 4404 of the *Astronomische Nachrichten* Herr J. Holetschek discusses the length of the comet's tail at different apparitions, *apropos* of the question whether the tail, on May 19, will extend far enough to envelop the earth. In 1759, when the earth passed through the plane of the comet's orbit on May 14, the tail exhibited large fluctuations in apparent length; on May 5 it was recorded as nearly 47° long, but on May 14 the recorded length was but 19°. Herr Holetschek gives the following values for the length at various apparitions, the first being a mean value, the second the largest value recorded; the unit is the earth's distance from the sun:—1456, 0·20, 0·39; 1531, 0·14, 0·17; 1607, 0·06, 0·12; 1682, 0·10, 0·22; 1759, 0·08, ??; 1835, 0·08, 0·17; in each case the first value is probably the length of the most brilliant, easily seen, part of the tail. For the tail to reach to the earth on May 20 its length must be 0·15 on this scale. Some amount of discussion has appeared in the daily Press as to the probability of its attaining the requisite length, and, to a representative of the *Daily Mail*, Mr. Crommelin suggested that the chances are about even; but there is no method of determining the probable length at any particular time, for comets' tails are so very uncertain in their behaviour.

THE VELOCITY OF THE SOLAR SYSTEM IN SPACE.—The results of a new determination of the velocity of the solar system in space are published by Prof. Stroobant as an extract from the *Bulletin de l'Académie roy. de Belgique* (No. 1, pp. 39–51, 1910). After discussing previous solutions of the problem, he takes Newcomb's later value for the apex (A=277·5°=18h. 30m.; D+35°), and, from the more recent determinations of radial velocities of stars, calculates the displacement of the sun in that direction.

From the discussion of the velocities of forty-nine stars situated near the assumed apex, Prof. Stroobant derives 18·75 km. as the velocity of translation of our system, and from fifteen stars surrounding the anti-apex he derives 21·55 km. per sec. Combining these results, he finds that, in regard to stars visible to the naked eye, the solar system is travelling towards the assumed apex with a velocity of 19·40 km. per second. This value is a little less than that (19·89 ± 1·52 km.) derived by Campbell taking the apex obtained by himself, and is much greater than that (16·7 km.) found by Kapteyn; it represents an annual displacement of 4·10 astronomical units. Prof. Stroobant tabulates the stars discussed by him, giving their positions, magnitudes, spectral types, &c., and shows that stars of different types give different values for the velocity of the solar system; thus twenty stars of the Orion type give a mean value of 22·5 km., and appear to constitute an individual system in the stellar universe.

STAR COLOURS.—In a paper which appears in No. 3, vol. xxxi., of the *Astrophysical Journal* (April, p. 234), Prof. Louis Bell discusses the reputed colours of the *comes* in double stars in relation to the known facts concerning the colours of stars and their spectra.

It is a fact, established by many investigations, that among the reported colours of double stars there are bizarre tints which are not met with among isolated stars. That this is not due to any physical connection between the *comes* is shown by the fact that it appears as strongly in the case of optical doubles as in the case of binary systems. The suggestion that these tints are merely subjective effects of contrast is generally countered by the statement that they are not always complementary, but Prof. Bell shows that this statement is not conclusive.

From a discussion of the spectra of a number of doubles, and from a number of experiments on artificial stars, he shows, fairly conclusively, that the reported tints are produced physiologically, and have no determined objective existence. As an example of the evidence deduced from the study of spectral type, he mentions 59 Serpentis, where the primary type i. is yellow and the secondary type ii. is blue; a type ii. star of a bright blue colour is unknown among isolated stars, and logically improbable. His experiments show that with artificial stars of unequal magnitudes, such as are found among double stars, "dazzle tints" and "fatigue" effects probably account for the curious associations of colours met with in the records of the colours of multiple stars and star-clusters.

THE FORMATION OF SATURN'S RING SYSTEM.—In No. 4403 of the *Astronomische Nachrichten* Prof. Lowell discusses the causes which have produced the present conformation of Saturn's system of rings. He points out that commensurability of period between perturbing and perturbed masses is a greater factor in determining their loci than is the more direct effect of attraction, and shows that in the case of Saturn's system the rings have their present conformations in accordance with this principle. Thus Prof. Lowell shows that, despite its smaller mass, Mimas has been the chief fashioner of the rings, aided by Enceladus and Tethys, in this order. Not only do the older divisions of the rings show this commensurability of period with the satellites, but newly discovered divisions occur at such distances as would give commensurability the greatest effect.

THE WATER PROBLEM.

THE discussion on the constitution of water which took place under the auspices of the Faraday Society on April 26 was remarkable for the presence of two distinguished foreign visitors, Prof. Walden, of Riga, and Prof. Guye, of Geneva, the former having travelled specially from Riga in order to be present, whilst the latter was able to arrange a necessary visit to London in such a way as to enable him to present his paper in person. Contributions to the discussion were also received from Mr. Sutherland, of Melbourne, and from Prof. Nernst.

Prof. Walker, of Edinburgh, occupied the chair, and in opening the discussion remarked on the extreme complexity of the problem of ascertaining the real nature of this commonest of all solvents, and on the great progress that had been made in recent years in the accumulation of quantitative data for its solution.

Prof. Walden's paper, "Is Water an Electrolyte?" included a number of observations that had been made in order to determine whether water, when dissolved in a medium possessing powerful ionising properties, might not itself become an electrolyte. To secure an adequate answer to this question, it was considered necessary to make use (amongst others) of media of which the specific inductive capacity was greater than that of water. The liquids selected were hydrogen cyanide, HCN; formamide, $H.CO.NH_2$; nitrosodimethylamine, $(CH_3)_2N.NO$; formic acid, H.CO.OH; and sulphuric acid, the first two solvents being characterised by a specific inductive capacity greater than 84, the value for water. In passing, it may be noted that Prof. Walden's discovery of the use of formamide as a solvent represents a "find" of extraordinary importance which, even if it stood alone, would form an adequate recompense for the labour involved in his masterly survey of the wide field of organic liquids; this solvent appears to reproduce nearly all the valuable qualities of water, including its convenient freezing point and boiling point and its powerful ionising properties, but will mix freely with important groups of compounds which do not dissolve to any marked extent in water.

Hydrogen cyanide, which with its high specific inductive capacity and great fluidity provides ideal conditions for electrolysis, was found when used as a solvent for water to give molecular conductivities of the order of 0·009 as contrasted with 300 for a salt such as potassium iodide; the low molecular conductivity of the water dissolved in hydrogen cyanide finds a parallel, however, in the low conductivity of hydrogen cyanide dissolved in water. Formamide, with a similar specific inductive capacity, but much smaller fluidity, gave for the molecular conductivity of water values (about 0·016) slightly higher than in the case of hydrogen cyanide. In the case of formic and sulphuric acids the specific inductive capacity is lower than that of water, sulphuric acid being further handicapped by its extraordinary viscosity, but both solvents gave increased values for the molecular conductivity of water, namely, about 0·17 in formic acid, but rising in the case of sulphuric acid as high as 74. From these observations it is clear that the conductivity attributed to the water does not

depend on the *physical* qualities of the solvent, but on some *chemical* relationship between solvent and solute. It was suggested by the author that water, acting as an amphoteric electrolyte, could form a salt when mixed either with a strong acid or with a strong base, and that the high conductivity of mixtures of sulphuric acid and water, and the slight conductivity of mixtures of formic acid and water, were due neither to free acid nor to free water, but to the presence of an oxonium sulphate or formate in the liquid. The absence of conducting power in mixtures of water with hydrogen cyanide or formamide was attributed to the weakness of their acidic and basic qualities and the impossibility of combining them with water to form a salt-like electrolyte.

Prof. Guye, in a paper "On the nature of molecular associations in the special case of water," referred to a new formula by which the coefficient of association of a liquid might be deduced from its molecular surface energy, and showed that in the case of water at the boiling point it gave the factor 1·96—a value considerably lower than that (2·66) deduced by Ramsay and Shields, but agreeing closely with a value (1·98) deduced by Walden by another method. He also described the results of a calculation whereby the degree of association of liquid water could be calculated from the degree of association of steam on the assumption that the law of mass-action held good in both cases; and that the value of the constant remained the same throughout. Taking the figure 1·089 given by Bose for the association-factor of steam, the value 1·99 deduced for water was shown to agree satisfactorily with those derived by the other methods referred to above.

The values given by Prof. Guye for the coefficient of association of water at 100° were, in the subsequent discussion, referred to by Mr. Bousfield, who pointed out that (if correct) they would render untenable Sutherland's theory that liquid water is a binary mixture of trihydrol and dihydrol, since even at 100° it would be necessary to assume the presence of considerable amounts of monohydrol in order to reduce the (average) association-factor below 2.

The paper by Mr. W. R. Bousfield and Dr. T. M. Lowry, on "Liquid Water a Ternary Mixture. Solution-volumes in Aqueous Solutions," was an extension to other solutes of some curious observations made five years previously in the case of aqueous solutions of caustic soda. The solution-volumes of the soda were found to vary largely with the concentration and with the temperature, the most remarkable feature of the variations being the occurrence of a maximum of solution-volume at about 60° C. in liquids of all concentrations. The gradual conversion of the ordinary, slightly concave, expansion curve into a strongly convex curve had now been traced through a series of solutes—chloral hydrate, sugar, acetic acid, silver nitrate, potassium, sodium, calcium and lithium chlorides. The curves for caustic soda were shown to be intermediate between those for sodium and calcium chlorides, and to form one member of a series of progressively changing types. The drooping of the ends of the curves was shown to depend on the occurrence during the preparation of the solutions of a contraction resulting from the formation of hydrates. Such a contraction indicates that water is increased in density by combining with a solute; in order to give definiteness to this conception, the suggestion was made that the density of combined water is similar to that of its denser constituent (dihydrol) in the free state, and that the contraction on dissolution is due mainly to the conversion into hydrate of *lighter* constituents present in the liquid. As this contraction in the case of lithium chloride solutions increases both above and below 40°, it follows that a lighter form of water is produced, not only by cooling, but also by heating it. The presence of three constituents in the liquid (ice, water and steam, or trihydrol, dihydrol and monohydrol) is indeed absolutely necessary in order to account for the complex changes of volume that have been observed in water and in the solutions prepared from it.

Mr. Sutherland's paper "On the constitution of water" had been circulated before the meeting, and owing to lack of time was taken as read. His suggestion that the hexagonal symmetry of ice crystals may be taken as evidence in favour of the "trihydrol" formula will now receive more serious consideration than would have been the case a few years ago; although his method of deducing the relative sizes of the atoms differs from that made use of by Barlow and Pope, and his method of "packing" is not the "closest" possible, there is no doubt that the general scheme of the arrangement is sound, and that the argument from crystal structure to chemical constitution may now be accepted as both legitimate and useful. Unlike the previous authors, Mr. Sutherland considers that monohydrol does not exist in liquid water, but is present in all salts containing water of crystallisation. He attributes to it a density (1·31 in the solid and 1·26 in the liquid state) considerably greater than that of dihydrol (1·13 and 1·09) or of trihydrol (0·92 and 0·88), and in an appendix gives values for a number of its other physical properties.

Prof. Nernst's paper on the specific heat of ice, water and steam was read by Dr. Wilsmore. The survey covered the whole field from −200° to the highest temperatures, but attention was directed specially to minima in the specific heat of water vapour under moderate pressures and of liquid water at moderate temperatures; both minima were attributed to the dissociation of complex molecules. The question of specific heats was also dealt with in a note on the specific heat of water of crystallisation by Mr. F. P. Sexton, of Truro, which was read by Dr. J. A. Harker. In the case of copper sulphate the first four molecules of combined water were found to have a specific heat 0·499, whilst the fifth molecule gave the value 0·508. Mr. Bousfield pointed out that the value 0·5 also held good for the combined water in solutions of potassium chloride, the heat capacities of which could be calculated correctly by assuming them to be mixtures of free water, hydrate-water, and salt. Dr. Senter pointed out that the values now given agreed well with the view, in support of which much evidence was available, that in compounds such as copper sulphate four molecules of water were definitely associated with the metallic atom, the remainder being perhaps attached to the molecule as a whole.

Early in the evening Mr. H. B. Baker showed a remarkable experiment on the influence of purification in retarding the action of water on sodium amalgam, the underlying idea being that if water could by purification be rendered non-conducting it might also be rendered chemically inactive. Similar experiments on the inactivity of highly purified nitric acid were described by Mr. Veley.

A complimentary dinner, the first in the history of the Faraday Society, was given in honour of its foreign guests, Profs. Walden and Guye, on Wednesday, April 27, under the chairmanship of the president, Mr. James Swinburne, F.R.S. The English guests included Sir William Ramsay, Sir William Tilden, Sir Joseph Larmor, Prof. H. B. Dixon, Prof. Divers, and Dr. Chree. In responding to the toast of the guests of the evening, Prof. Walden referred to the scientific relationship between Russia and Great Britain, remarking, incidentally, that the first Russian chemist was an Englishman, sent by Queen Elizabeth to Russia in the sixteenth century. Prof. Guye dwelt on the debt which chemists all over the world owed to Faraday, and gave an interesting account of Faraday's visit to Geneva when he accompanied Sir Humphry Davy on his tour through Europe.

T. M. L.

RECENT ADDITIONS TO IDEAS REGARDING THE INTERNAL STRUCTURE OF THE EARTH.[1]

BEYOND the superficial observations made by geologists, not extending more than about one two-hundredth of the radius below the surface, even by indirect means, we are dependent on mathematicians for our ideas regarding the physical state of the earth's interior; these ideas are based on extrapolation from physical constants obtained in the laboratory, and their variety extends to the number of possible permutations and combinations of the three physical states of matter—solid, liquid, and gaseous. Halley's conception of a core and shell rotating at different speeds has been revived by Sir F. J. Evans (1878) and by the distinguished founder of this series of lectures to explain the secular variations of magnetism. The Laplacian hypothesis, based on Clairault's theorem, is now

[1] Abstract of the Wilde lecture delivered to the Manchester Literary and Philosophical Society on March 22, by Sir Thomas H. Holland, K.C.I.E., F.R.S.

being superseded in many minds by Chamberlin's planetesimal theory, after having inspired petrologists with a vain hope of finding traces of the primeval slaggy crust among the Archæan gneisses. Astronomers prefer a solid globe, but on grounds different from those assumed by Hopkins and at first accepted by Lord Kelvin. Arrhenius concludes in favour of a gaseous core, like that postulated by Ritter, but of larger dimensions than the gaseous core suggested by Dr. Wilde.

Theories regarding the processes of consolidation, the gradient of pressure, and the deep-seated rise in temperature are equally varied. Until this year all agreed in assuming the earth's interior to be hot, but Prof. Schwarz now prefers to think it is cold. So long as radio-active bodies were unknown the apparent reserves of heat-energy offered the world a short life; but its actuarial value has now been increased almost indefinitely by the discovery of radium in embarrassingly large quantities, and Prof. Joly warns us that, instead of peaceful cooling, the present "age" may end in catastrophic heating.

The nearest approach to actual observation regarding the deep-seated parts of the globe is recorded by the seismograph as interpreted by R. D. Oldham, who aptly compares the seismograph with the spectroscope as an instrument for examining inaccessible objects. The first and second phases of long-distance seismographic records, which are due to waves passing through the earth by approximately chordal paths, show a reduction in velocity when there is a sufficient distance between the origin of the shock and the recording instrument for the assumed chordal paths to pass through the inner two-fifths of the earth's core, while the distortional waves are apparently dispersed by refraction when the origin of the earthquake and the recording instrument are separated by about 140°. The records, which are confessedly too few to be regarded as conclusive, suggest that the central core differs in physical characters from the outer three-fifths and the superficial crust. Similarly, the vibrations that pass under the great oceanic depressions indicate elastic conditions differing from those under the continental plateaux, the difference being apparent to a depth of about one-quarter the earth's radius. This last conclusion might be correlated with the variation in the chemical composition in the sub-oceanic crust caused by selective denudation of the kind indicated by Sir John Murray in 1899, and by Chamberlin's theory regarding the origin of the oceanic depressions.

The recent discussions and new data obtained by geodesists and geologists to check Dutton's theory of isostasy have revived interest in the deep-seated parts of the superficial crust. The remarkable work recently done in India by Burrard and Lenox-Conyngham, when correlated with the results of the Geological Survey, are especially important in showing the truth and the limitations of isostasy. Burrard's results indicate that the Himalayan heights are partly compensated by deficiencies of subterranean gravity, and that greater loads are maintained by the rigidity of the geologically stable crust of the peninsula than in the folded parts of the extra-peninsular region. The deficiency of gravity under the outer and sub-Himalaya is, however, equally pronounced in the plains near the southern foot of the range; but at a distance of about 150 miles from the foot of the mountains there is a subterranean band of high gravity parallel to the alluvium-filled Gangetic valley, as well as to the four Himalayan zones—the foot-hills, composed of Tertiary strata; the outer Himalaya, of much older, unfossiliferous sediments; the crystalline range of snow-covered peaks; and the Tibetan highlands of fossiliferous, marine strata.

Soon after Dutton published his theory of isostasy, R. S. Woodward pointed out that, if the highlands continued to rise in consequence of the reduction in their load by erosion, and the depressions continued to sink under the growing weight of accumulating sediment, the process should continue indefinitely, and mountain ranges would thus never be worn down, while new folds in undisturbed areas would never arise; but the geological history of India shows why and how this process may result in "isostatic suicide." For ages before the end of the Mesozoic era the rivers of Gondwanaland, which stretched away as a great continent to the south and west, poured their loads of silt into the Eurasian ocean, of which the southern shore-line approached the line now occupied by the Himalayan snow-covered peaks. With the loading down of the northern littoral of Gondwanaland, the northern part of the continent became stretched, and normal faults were developed with a general east to west trend.

Some of the faults of this kind occurring in the Central Provinces were shown by J. G. Medlicott, so long ago as 1860, to be pre-Gondwana (that is, pre-Carboniferous) in age, others were formed before the Upper Gondwana (Lower Mesozoic) strata were formed, while the latest affected the younger Gondwana beds, and became channels for the Upper Cretaceous basalts. The general trend of the Cretaceous dykes in this part of India, and the prevalence of normal faults further east at about the same latitude, shown in various geological maps published by later members of the Geological Survey, indicate the nature and direction of the tension produced by the unloading of Gondwanaland and the simultaneous depression of the adjoining ocean bed. The process reached its climax towards the end of Cretaceous times, when the basaltic magma below welled out and flooded more than 200,000 square miles to a depth of nearly a mile.

Presumably the tension marked by faults in Central India existed also in areas further north, where the records are now buried under the Gangetic alluvium, and the band of high gravity detected by Burrard's plumb-line and pendulum is probably due to concealed batholiths of basic and ultra-basic magma, which were injected into the region of tension after the manner described by Prof. R. A. Daly.[1] Then followed the production of a geosyncline parallel to the northern shore-line of the old Gondwana continent and parallel to the subsequent folds of the Himalayan range, which are now being thrust over towards the region of deficient gravity between the visible mountain range and the concealed band of basic batholiths.

The data in this area are in substantial agreement with Daly's idea of a persistent sub-crustal gabbroid magma, which, though possibly only in a state of potential fusion under regions of normal pressure-gradient, may become fluid in localities of protracted erosion and gradual rise of the northern shore-line of the old Gondwana continent and agree, in general, with those analysed by Hayford and others in America in showing that isostasy can be detected only when the visible masses over wide areas are concerned; further data of this kind will permit of the determination of the minimum loads that can be maintained by the crust in old stable land surfaces as compared with the apparently smaller loads maintained in recently folded regions. If the sequence of events in India has been correctly traced, it should be possible to indicate areas on the earth which are in danger of basaltic floodings and of later folding movements. In South America, for instance, the north-flowing tributaries of the Amazon and the Araguaya are possibly developing conditions on the old land surface of Brazil similar to those that on Gondwanaland preceded the outburst of the Deccan Trap in Cretaceous times.

THE HULA, OR FOLK-DRAMA OF HAWAII.

THE Hula, or national folk-drama of Hawaii, has already been casually described by the Rev. W. Ellis in his "Polynesian Researches," and has been noticed in the "Travels" of Captain Cook; but it was left to Dr. N. B. Emerson to undertake a detailed investigation of the unwritten literature of the island, and to make a collection of the songs sung in these performances. The results of this study have been published in Bulletin No. 38 of the American Bureau of Ethnology. We may congratulate this institution on having now, for the first time, under the authority of a special Act of Congress, extended its operations beyond the bounds of the American continent.

The Hula is a special form of folk-drama, dealing in a series of impassioned lyrics with many phases of the national mythology and traditions. The poetry is of a highly romantic and sensuous type, including themes connected with human love and life, the processes of nature,

[1] "Abyssal Injection as a Causal Condition and as an Effect of Mountain-building," by R. A. Daly (*Amer. Journ. Sci.*, xxi., 1906, pp. 207–13).

the mysteries of the spirit world, described by a series of metaphors and personifications. Much of it is of very ancient date, and is hardly intelligible even to the best native scholars at the present day. In studying the translations and analysis of Dr. Emerson, we cannot avoid the suspicion that much is vague and uncertain, and that the interpretations may sometimes ascribe to these apparently meaningless songs a significance which reflects modern romantic conceptions alien to the spirit of the early singers. Throughout the whole drama the themes are essentially religious. The chief deity invoked is Laka, the impersonation of the powers of vegetation, who is addressed in special hymns and worshipped at an altar adorned with leaves and flowers of those plants which are believed to be specially acceptable to the goddess, because they are the forms in which she prefers to manifest herself. With her are invoked the spirits of the wood, which resemble the fairies of Europe, Pele, the goddess of the volcano, and her sister, Kapo, who, like the Mother goddesses in other parts of the world, assumes a dual form—benevolent as a sylvan deity, chthonic or lewd, the latter phase being only occasional.

As Mr. A. Lang has pointed out, the mysteries of Greece

Woman playing on the Nose-flute (Ohe-hano-ihu).

can best be interpreted on the analogy of rites among savage or semi-savage races. The Hula accordingly presents notable resemblances to the Greek Eleusinia and similar celebrations. The performers are carefully selected; they must observe stringent purity tabus, sexual license being prohibited; they are kept in a special enclosure, which they must never leave except with muffled heads, and they must engage in no conversation beyond its limits; above all things, they must avoid contact with a corpse. As the Greek hierophant proclaimed, "Ye mystae, to the sea!" in Hawaii the performers rush into the ocean, going and returning in a state of nudity; there is a pass-word of admission, a prayer at the beginning and end of each performance, and a special supplication for the removal of tabu; a ritual dress, modelled on the primitive fig-leaf. Finally, the central act of the rite is a form of sacrament. A cooked pig is brought into the assembly, and the hierophant, acting as carver, "selects the typical parts—snout, ear-tips, tail, feet, portions of the vital organs, especially the brain (*lolo*). This last it is which gives its name to the ceremony. He sets an equal portion before each novitiate. Each one must eat all that is laid before him. It is a mystical rite, a sacrament; as he eats he consciously partakes of the virtue of the goddess that is transmitted to himself."

The Hula assumes various forms. A special type is assigned to each instrument—the drum, the gourd rattle, the bamboo rattle, a kind of xylophone, pebble castanets, a hollow bamboo beaten on the ground, a jew's harp, and that remarkable instrument the nose-flute. Others include the use of marionettes, or mimetic delineations of animals, as the shark and dog dances.

On the whole, this elaborate study of a primitive folk-drama is interesting from many points of view—as a description of savage music recorded in the recognised notation; as throwing fresh light on the problem of the mysteries; as a new conception of folk-poetry, with its sensuous, enigmatic lyrics. Lastly, it throws novel light on the interpretation of the popular mythology and traditions. If we cannot always accept Dr. Emerson's interpretations of the materials which he has collected, we can admire the industry and insight which appear throughout this volume.

PIGMENTATION AND CANCER.

Does the absence of skin pigment predispose white men to cancer? This question has been answered in the affirmative in a paper[1] which has attracted some attention. The author, Dr. Watkins-Pitchford, adduces instances of the inverse ratio obtaining between the degree of pigmentation of the skin and of the body cavity, and explains that the external and internal pigmentations protect the tissues from excessive "irradiation" by actinic rays, of which the influence is assumed to be highly inimical to the life of the individual. More weight would have attached to his observations, in whatever bearing they have upon cancer, had the thickness of the body wall been considered in relation to the degree of internal pigmentation and the slight penetrating powers of many of the rays loosely called actinic.

"White man is of all animals the most liable to cancer" forms the postulate from which the author elaborates his views. This is an old dogma which is by no means universally accepted as true, and for certain individual organs is now proven to be false. For example, cancer of the mamma is probably as frequent in Indian hospitals as it is in London, and it is as common in the mouse as it is in the human female. It certainly occurs in the native African negress more frequently than was formerly supposed. However, the author brings this first postulate into line with his second, "the absence of effective pigmentation, or other form of external protection, in white man is the primary cause of his liability to cancer"; the same holds for domesticated animals. The liability to cancer should therefore be found increasing in proportion as pigmentation is decreasing, and the true albino of any species, man included, should display the greatest liability of all. A table is given to illustrate the scale of liability of black, brown, red, yellow, and white races of man by estimations of "probable" cancer death-rates for Zulus, Tamils, Red Indians, Chinese, Italians, English, Dutch, and Swedes. The figures can be definitely stated to be worthless for purposes of comparison. Those for the Chinese in the United States are meant to show the intermediate incidence of cancer in the yellow race; but why not have chosen the Japanese, who have relatively excellent national statistics showing more than 25,000 deaths annually, and who admit that this number is far short of the total, which would represent a death-rate probably not less than in England? The Italian figures presumably represent "brown" man, but the Italian national statistics are among the worst in Europe, and cannot be compared with English statistics. The table merely gives a list of increasingly worthless figures and correspondingly untrustworthy records of the occurrence of cancer. The argument would, however, break down for another reason—by its failure to explain the frequency of cancer in the negroes of America as contrasted with its real or apparent infrequency in Africa.

1 "Light, Pigmentation and New-growth, being an Essay on the Genesis of Cancer." By Dr. Wilfred Watkins-Pitchford. Pp. 150. Read at the South African Medical Congress, Durban, August 2, 1909.

The general application of an inverse relation between degree of pigmentation and liability to cancer cannot be maintained, and it fails equally when applied to explain the varying incidence of the disease in different anatomical sites of the body. For carcinoma of the breast, the argument is much as follows. The woman of the white variety of mankind stands erect with her mammæ projecting, and fully exposed to direct solar irradiation; she has no pigment or hair to aid her delicate, translucent skin in protecting the glandular epithelium lying immediately beneath the surface. She covers her bosom with a single garment—the flimsiest of white silk blouses. The man, in addition to wearing shirt and underclothing, protects his chest from irradiation by coat and waistcoat of dense cloth and of dark colour. Hence there are 100 cases of cancer of the breast in the woman to one in the man. The differences between the male and female, and between the mammary glands in the two sexes, are not of the subordinate importance assigned to them in determining the onset of cancer. They are of primordial importance, since the difference between the male and female obtains for all species liable to carcinoma mammæ.

The frequency of this form of cancer in the woman requires to be considered, almost certainly, from totally different points of view. Not only do the sites of predilection vary from one class of vertebrate to another, but, if the Mammalia themselves be considered, some species are very liable to cancer of certain organs from which others, even nearly allied, are relatively or altogether exempt, as illustrated, *e.g.*, by the variations in the frequency with which the mamma is attacked. The liability of the woman is merely a peculiarity shared, *e.g.*, with the female of the mouse and dog, whereas in other domesticated mammals, *e.g.* in the cow, cancer of the mamma is practically unknown. Equal degrees of "irradiation" will not harmonise the parallel liability of the woman and the female wild mouse to cancer of the mamma, nor will differences in "irradiation" explain the exemption of the cow and the proneness of the tame albino and the wild grey mouse to this form of the disease.

These specific differences in liability depend in part, at any rate, on something more than external conditions. Under very divergent conditions, as regards habits (exposure to daylight), environment, and food, the incidence of cancer may be parallel, as in the case of the tame and wild mouse. Therefore innate fundamental tendencies of much biological import cannot be dismissed by assuming that cancer occurs in the mamma of dogs because the abdomen is "irradiated" through sitting up when "begging," or in consequence of a too great fondness for lying before an open fire. Nor can the biological significance of the sites of predilection for cancer of the rectum and uterus in mankind be explained by their corresponding with the sites on which a full bladder focusses actinic rays! The assumption that organs which are dark red or brown in colour are less liable to cancer than organs of a lighter colour will not explain why primary carcinoma of the liver is more frequently recorded in cattle than in other domesticated mammals.

A real and grave increase in cancer is asserted to have occurred during the past fifty years, and the attempts to allay tendencies to public panic by soothing assurances to the contrary are stated to be a praiseworthy policy, but intentionally misleading. This is rather a grave charge to bring, without substantiation, against investigators who have as much claim to be taken seriously as has Dr. Watkins-Pitchford in his explanation of the increase he alleges, viz. that there has been a decline in the use of woollen garments during the past fifty years, a change in the colour of the clothing worn, and that black broadcloth and black silk have ceased to be the clothing of respectable society, except the clergy, who enjoy a "privilege of cloth," and with it a low cancer death-rate.

In short, the prevention of cancer is represented as a matter of effective protection against solar irradiation, to which white man, having lost his pigmented skin, exposes himself both blindly and nakedly; but, we pause to ask, How is it, then, that the black-coated mouse is as liable to cancer as is the albino? We wonder if the difference in the recorded frequency of cancer in black and white man is the result of imperfect opportunities for observing the disease in the former, and of the attainment of the cancer-age by a smaller relative number of individuals. We remember that the black man and woman are by no means exempt from cancer, and we regret that the drudgery of putting their opinions to a sufficient test is not undertaken personally by a large army of arm-chair speculators who essay to write on the nature, cause, prevention, and cure of cancer. This punishment should certainly be theirs.

E. F. B.

CHEST DEVELOPMENT IN BOYS IN NEW SOUTH WALES.

THE New South Wales branch of the British Science Guild has just circulated a report in which it states that a special sub-committee investigated a number of points in connection with the physical development of boys in New South Wales, and compared the results with those of other countries. It was found (1) that the average girth of English boys round the chest is roughly 3·6 inches more than that of boys in New South Wales at seventeen years of age; (2) Tasmanian boys have always measured rather more than New South Wales boys round the chest, and at the late age of sixteen or seventeen years they come approximately to the English average; (3) the chest growth of the New South Wales boy is at all ages much less than that of the Washington boy, viz. at nine years nearly 1 inch, at ten years more than 1 inch, between thirteen and fifteen years 1½ inches or more; (4) as a result of this the lung capacity of New South Wales boys averages at all ages much less than that of the American boys, and the deficiency varies from 500 c.c. at nine years of age to 625 c.c. or more at seventeen years.

The committee found it difficult to give a complete estimate of the causes of this devitalising condition, the factors at its disposal being too indeterminate, but the suggestion is offered that the habit of the young Australian of leaning against lamp-posts and door-posts, or the difficulty with which he can be got to walk for an outing so long as there is a conveyance to be had, or his inveterate custom of supporting the games of cricket and football by leaning across a fence or resting his form upon a shaded bench while he bets upon the odds or barracks more or less enthusiastically, have to be considered in this connection.

The executive council of the Guild at Sydney passed the following recommendations:—(1) that the attention of the Government and municipal councils be drawn to the supreme importance of providing areas specially set apart and adapted for the purpose of healthy games, it being understood that such areas should be left bare of trees and flowers, save on borders, and should be provided with running tracks and facilities for cricket, football, lacrosse, basket-ball, and similar games; (2) that as the principle of taxing the unimproved value of land is a direct discouragement to schools to provide such areas, representation should accordingly be made to the Government and to municipal councils to allow some substantial concessions to all *bona fide* schools providing adequate playgrounds, such playgrounds being, like parks, really a guarantee of the people's health.

THE ADMINISTRATION OF ANÆSTHETICS.

THE report recently presented to Parliament concerning deaths resulting from the administration of anæsthetics (Cd. 5111, price 1*d*.) touches upon a matter of grave public interest, in which expert medical opinion and questions of pure science and the common sense of the intelligent "man in the street" alike contribute. We may say at once that the report appears to us to be of high value; it recognises a danger that for many years past has weighed very seriously upon the minds of those who know the danger, namely, of sudden death during the administration of chloroform, and it ends by recommending towards the remedy of this danger that a small standing committee or commission should be appointed to deal with the subject under the control of the Home Office.

The body of the report, although offering, no doubt, points open to criticism by individual authorities, is, on the

whole, unexceptionable as an expression of the resultant opinion received from many different sources. It is recognised at the outset that a "certain number" of deaths are due to preventable causes, and that a "certain number" of deaths are inevitable, which obviously signifies that the actual numbers of preventable and inevitable deaths are quite undetermined. One of the first services to be expected from a standing committee of experts would be information as to the relative proportions between these two classes of deaths. Idiosyncrasy as a factor cannot be eliminated. Anæsthetics, like all other poisonous drugs, act differently on different constitutions. Alcohol in known quantity does not necessarily produce identical effects upon different persons, but, as regards chloroform, ether, and other poisons, before we are entitled to appeal to idiosyncrasy we require to know what quantity of any one of these poisons may have been actually administered. Such information might usefully be acquired at small cost by a standing committee of the Home Office, and made available to the medical profession and to the intelligent laity in a convenient form.

The use of anæsthetics "of longer duration," inclusive, presumably, of chloroform, for the purposes of minor surgery, including dentistry, is considered in paragraphs 9 and 10 of the report. Although evidence was offered on behalf of the Incorporated Society of Extractors and Adaptors of Teeth to the effect that there had been 1,249,167 administrations of general anæsthetics by members of the society with only one fatal accident, the committee is of opinion that the administration of those anæsthetics the effect of which is of prolonged duration should be confined to qualified medical men.

The report is almost precisely on lines recommended by the General Medical Council in that it urges the need of legislation, that it recognises the necessity of limiting the administration of general anæsthetics to *qualified* medical and dental practitioners, and of prohibiting single-handed anæsthetising and operating.

There is no doubt that this report may prove to be the initial point leading to the acquisition of much useful knowledge and to greatly increased safety in the increasing number of cases where, thanks to Lord Lister and to the system of aseptic surgery, operations are possible, and anæsthetics therefore required. In the words of the report, there is need yet for much careful clinical observation, controlled, if necessary, by physiological experiments.

METRIC MEASURES.

THE Decimal Association has recently issued a circular on the progress of the metric system of weights and measures in this country, and also two papers written by Mr. Aldred F. Barker, director of textile industries at the Bradford Technical College, advocating the adoption of the metric system in the textile trade. It appears from the circular that the total number of metric weights and measures verified in the United Kingdom during the year ended March 31, 1909, was 8797. As this was the first year in which the obligation upon local authorities to distinguish between metric and imperial weights and measures in their returns to the Board of Trade was enforced, comparisons of this total with the totals for previous years, as furnished in the returns, would necessarily be misleading; but it is evident that the metric system is making steady headway here. Of the weights and measures verified and stamped in this country during the year in question, 1 in 1280 belonged to that system. Opponents of the metric system have an axiom to the effect that, whatever its merits, its compulsory introduction would be absolutely disastrous to the great textile industry. Mr. Barker's papers form a highly technical refutation of this axiom. He shows that the metric system could be adopted by the industry with a minimum of inconvenience, and that it would afford a more methodical and practical basis for those mysterious lists and tables which are to the textile trade what the Nautical Almanac is to the astronomer.

Mr. L. J. Spencer, of the Mineral Department, British Museum, has contributed to the March number of the *Mineralogical Magazine* an interesting paper on the weight of the "Cullinan" diamond, and on the value of the carat weight. He directs attention to the discordant values given by various authorities for the weight of the "Cullinan" diamond expressed in carats, and points out that the adoption of an international standard carat would be the best means of preventing such discrepancies in estimations of the weights of precious stones. The "metric carat" of 200 milligrams, the adoption of which was advocated by the International Conference on Weights and Measures in 1907 as a universal standard, has met with considerable support abroad, but diamond dealers in this country are not at present disposed to abandon their time-honoured but diverse-valued carat of about 3⅛ troy or avoirdupois grains, the various equivalents adopted for which by different firms do not appear to cause much inconvenience to the trade. In these circumstances, only the exclusive adoption of the metric carat by all the more important foreign States would render official action possible towards its legal recognition or compulsory adoption in the United Kingdom.

FUNGAL STUDIES.

MR. C. L. MOORE has followed up his studies of the Myxomycetes of Picton County in Nova Scotia, by a short account of some Nova Scotian aquatic fungi referred to the species Saprolegnia, Achyla, Aphanomyces, Leptomitus, and Sapromyces. The paper, which is published in the Transactions of the Nova Scotian Institute of Science (vol. xii., part iii.), contains figures and descriptions of the antheridia and oogonia for most of the species.

An important contribution to the literature on the Mycetozoa is provided by the list of species from Ceylon compiled by Mr. T. Petch, which is published in the Annals of the Royal Botanic Gardens, Peradeniya (vol. iv., part vi.). The list enumerates 102 species, the majority of which are also found in Europe; *Alwisia bombarda* and *Erionema aureum* are two tropical species recorded from the wet country. The commonest species are *Didymium effusum, Physarella mirabilis*, and *Hemitrichia clavata*. Physarella may be said to invade the laboratory, where it develops on logs kept for growing other fungi. Mr. Petch notes that there is a greater tendency for the plasmodium to wander than in Europe, which he ascribes to the greater rainfall and humidity. *Stemonitis herbatica*, Physarella, and *Didymium effusum* have been gathered, from the crowns of palm trees, 20 feet from the ground; *Perichaena chrysosperma* frequently ascends to a height of 50 feet on Bombax trees.

Mr. Petch has also prepared a second part of his revisions of Ceylon fungi, which appears in the same number of the Annals. As a result of the examination of fresh specimens, a number of specific names have been reduced to synonyms. It is noted that certain characters generally regarded as specific may sometimes be merely variations due to weather. Thus the white gills of *Lepiota Zeylanica* in showery weather pass through a yellow stage before changing to red, whereas in fine weather the yellow stage is not evident. Again, the stipe of *Lepiota pyrrhaes*, which ordinarily bears an annulus and scales, appears smooth and ringless when grown in a saturated atmosphere. With reference to the genus Auricularia, the author offers several reasons for recognising two species *Hirneola polytricha* and *Auricularia tremellosa*, both distinct from the common European species *Auricularia auricula judae*.

The October (1909) number (vol. cxviii., part viii.) of the *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften*, Vienna, is entirely devoted to botany. Prof. von Höhnel contributes a further set of notes on Javanese fungi. He creates a new genus, Treubiomyces, for a fungus (Nectriaceæ) collected on leaves of *Ficus elastica* which bears rough patches of clustered hyphæ surmounted by long hairs. Another fungus, *Limaculina samoensis*, taken on the same host, is characterised by a perithecium raised on an under layer of hyphæ, the *subiculum*, which bears short round cells and stellate spores. In the same number Dr. P. Fröschel communicates a short paper on the latent period in heliotropic experiments, in which he

confirms the results of Blaauw that the light of a mercury vapour lamp or direct sunlight acting for a period of 1/2000th second is sufficient to produce a stimulus. Mr. F. Kölbl, describing his experiments on the heliotropic sensibility of woody plants, notes that shrubs are more sensitive than trees.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Honorary degrees will be conferred this term upon Sir Oliver Lodge, F.R.S., principal of the University of Birmingham, and Prof. W. H. Perkin, F.R.S., professor of organic chemistry in the Victoria University of Manchester.

Mr. K. J. J. Mackenzie has been appointed university lecturer in agriculture for five years as from January 1, 1910.

Dr. T. Percy Nunn, vice-principal of the London Day Training College, will give a lecture on psychology and some problems of education on Friday, May 13, at Gonville and Caius College. The lecture will be open to all interested in the subject.

OXFORD.—The Romanes lecture for 1910 will be delivered in the Sheldonian Theatre on Wednesday, May 18, at 2.30 p.m., by the Hon. Theodore Roosevelt, ex-President of the United States of America. The subject chosen by Mr. Roosevelt is "Biological Analogies in History." Lord Curzon of Kedleston, Chancellor of the University, will preside.

The first Halley lecture, established "in honour and memory of Edmund Halley (sometime Savilian professor of geometry in the University and Astronomer Royal) in connection with his important contributions to cometary astronomy and to our knowledge of the magnetism of the earth," will be delivered on Tuesday, May 10, at 5.30 p.m., in the University Museum, by the founder, Dr. Henry Wilde, F.R.S. The title of the lecture is "On Celestial Ejectamenta."

DR. E. J. GODDARD, Linnean Macleay fellow in zoology, Sydney, has been appointed by the council of Stellenbosch College, South Africa, to the chair of zoology and geology in succession to Prof. R. Broom.

THE thirty-seventh annual dinner of old students of the Royal School of Mines will be held on Thursday, May 26, at the Hotel Cecil. The chair will be taken by Sir Thomas H. Holland, K.C.I.E., F.R.S.

A COURSE of eight lectures on "The Chief Animal and Vegetable Pigments" will be delivered in the Physiological Institute (University College) of the University of London on Fridays during May and June, commencing on Friday, May 6, by Dr. S. B. Schryver. The lectures are open to all students of the University, and also to all qualified medical men and other persons who are specially admitted.

IN an article in the current number of the *Oxford and Cambridge Review*, Mr. John C. V. Bevan, formerly Rhodes scholar and fellow of University College, Oxford, combats a statement which has been circulated that there is no return to the countries which send Rhodes scholars to Oxford. It appears that, of eighty-two Americans, eighty-one have returned home, while one has accepted a university appointment in England. Of fifteen Germans, fourteen have returned to the Fatherland, and one has gone to America. Seventy-eight colonials have completed their tenure as Rhodes scholars; fifty-one have already returned to their colonies; twelve are completing a further course of study before they return; three have obtained appointments in India; two in colonies other than their own; two in foreign countries; one is temporarily engaged in parochial work in this country; four have accepted teaching posts in English universities, but are hoping to secure professorial appointments in their own colonies; three only have decided definitely to settle in England.

A REPORT as to the disposal of the balance of the grant to university colleges of 100,000*l.* for 1909–10, and as to changes in the list of participating colleges, has been sent to the Treasury by the advisory committee on the grants. The report, together with Treasury Minutes thereon, has been printed and circulated as a Parliamentary Paper (110). The committee has already recommended the payment to the recognised colleges of general grants for the year 1909–10 on the same basis as in the two preceding years, and it now recommends the payment of further grants to thirteen colleges, varying in amount from 2000*l.* to Victoria University, Manchester, to 500*l.* to University College, Reading. The committee has had under consideration whether any new colleges should be added to the list of those which participate in the Treasury grants. Special attention has been given to the claims of Hartley College, Southampton; Royal Albert Memorial College, Exeter; East London College; and Birkbeck College, London. The committee recommends in regard to Hartley College, Southampton, that it shall not remain permanently on the list of university colleges in receipt of Treasury grants, and that its grant, reduced to 1500*l.*, shall be continued for the year ending March 31, 1911, but no longer. The committee has felt unable to recommend the award of a Treasury grant to the Royal Albert Memorial College, Exeter, and Birkbeck College. It recommends, however, that the East London College be awarded a grant subject to conditions set forth in the report, and will consider at what amount the grant for the quinquennium beginning with the year 1910–11 shall be fixed. The Treasury has concurred in the committee's recommendations, and will give effect to them.

Two fellowships, to be known as the "A.K. Travelling Fellowships," are to be established in the British Isles by M. Albert Kahn, of Paris, for the purpose of providing selected persons with *bourses de voyage* to enable them to travel in foreign countries. Each fellowship is to be of the value of 660*l.* This sum is to be expended by each fellow as to 600*l.* in defraying his travelling expenses, and as to 60*l.* in the purchase of books and souvenirs. The only condition which each fellow is required to fulfil is that he shall, at the expiration of his fellowship, prepare a report containing his impression of the countries he has visited. It is the desire of the founder that these travels shall be used as an opportunity of acquiring knowledge and experience which will be of use to the fellows in their future careers as teachers, scholars, or investigators. M. Kahn has arranged that his intentions shall be carried out by a board of trustees, consisting, in the first instance, of the Lord Chancellor, the Lord Chief Justice, the Speaker of the House of Commons, the principal of the University of London, Lord Avebury as nominee of the founder, and a sixth person to be elected by the other trustees. From an article in the *Times* it appears that the trust is to be associated permanently with the University of London, and this has been carried into effect by the principal of that University being appointed as one of the trustees. He will also act as the honorary secretary to the trust, and the office through which the trust will be administered will be in the University building. The trustees have been instructed to invite nominations from the Vice-Chancellor or other executive head of each of the universities in the United Kingdom, from the president of the Royal Society, and from the president of the British Academy, although they are not required to confine their election to the persons so nominated.

LAST September Dr. A. D. Waller, F.R.S., delivered an address to the University of California, and the substance of it is published in the current issue of *Science Progress* as an article entitled "The University of London and an Imperial Institute of Science." Dr. Waller directed attention to the immediate future of the University and to some of the first principles that determine the healthy university in the healthy community. Incidentally, he pointed out that it is upon the combination between teaching and research, and not upon their separation, that the intellectual welfare of a community and of an individual depends. The best guide to any district of knowledge is the man who has been there himself as an explorer or as a pioneer. Discussing university research fellowships, he maintains that no condition of life is more enviable than that of a keen-brained man during the best ten years of intellectual life, from, say, the age of twenty-five to that of thirty-five, in receipt of a salary of 200*l.* for teaching during half the week and of a fellowship of 200*l.* for "researching" during the other half. Under such conditions of life the return

in teaching power will repay the outlay in money, and that from among the workers thus supported the exceptional man will be far more likely to emerge than is the case now. The practical measures by which it is possible to give effect to this dual principle in London are such as would at the same time constitute an intercollegiate bond of union formed by the university between its colleges, schools, and institutions through its faculties and boards of studies. The formation of this bond of union should consist in the foundation of an Imperial Institute of Science and Learning, of which the present Imperial Institute building should be the home and headquarters, and its *personnel* select panels of university research fellows. Such panels should consist of professors, recognised and probationary teachers, and other distinguished persons in London, in the United Kingdom, and in His Majesty's Dominions beyond the Seas, selected and nominated by boards of the faculties appointed by the university.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 28.—Sir Archibald Geikie, K.C.B., president, in the chair.—R. B. **Sangster**: The rotatory character of some terrestrial magnetic disturbances at Greenwich and on their diurnal distribution. The paper commences with an investigation of the changes in direction of the line of total magnetic force at Greenwich on 1903 October 12d. 18h. to 23h., when a considerable magnetic disturbance was in evidence. Measurements of the published registers of all three force components were made at equivalent time intervals of about five minutes, whence is obtained a diagram showing the variation of the force component perpendicular to the line of total force. The diagram shows there was an almost wholly rotatory motion of the transverse disturbance vector, the trace consisting of six distinct convolutions varying greatly in size, but consistent in anticlockwise progression. Several other disturbances during epoch 1900–7 are examined in detail, and it is shown that a right- or left-handed rotatory character in the motion of the disturbance vector was of fairly frequent occurrence, while change from left to right not uncommonly occurred about midnight. It was also found that the same direction of rotation often persisted for several hours, and tables of the diurnal distribution of right- and left-hand rotatory disturbance are furnished to show that those of right-hand character were entirely absent during the hours 4 p.m. to 9 p.m., while, meantime, the left-handed rotations were very prevalent, and reached a notable maximum at 8 p.m. Other points in the diurnal distribution are noted, including the more decided effect resulting from a seasonal grouping of the seventy disturbed days dealt with.—D. Orson **Wood**: The liberation of helium from minerals by the action of heat. Experiments were made to determine how the volume of helium liberated from radio-active minerals by the action of heat depends on the temperature, and on the time for which that temperature is maintained, in particular with the view of the future use of heat to release all the helium contained in minerals not easily treated by chemical methods. The minerals experimented on were monazite and thorianite, the one comparatively poor and the other very rich in helium. The ground minerals were heated, *in vacuo*, in tubes of Jena glass or quartz, by an electric heater consisting of a single coil of nickel wire, to temperatures up to 1200° C., which were measured by a Pt resistance thermometer or a Pt Pt-Rh thermocouple. The gas released was purified by drawing it through KOH and P_2O_5 tubes, and finally by Na–K electrodes. The volume was measured in a modified McLeod gauge (described by Prof. Strutt, Proceedings, vol. lxxx.) specially constructed for the measurement of volumes over a large range—1 c.c. to 1 c.mm. Curves are given to show the volume of helium liberated with time at constant temperatures (250°–1000° C.), and also the percentage of the total content obtainable after prolonged heating at the different temperatures. The way in which the gas must be supposed to be retained within the mineral to accord with the results obtained is discussed, and it is concluded (1) that heat may be used for the complete liberation of the gas if a sufficiently high temperature (about 900° C.) is reached, and (2) that the results are in agreement with the supposition that a small proportion of the gas is diffused through the mineral and that the remainder is concentrated in very minute cavities within it.—Prof. Swale **Vincent**: The chromophil tissues and the adrenal medulla. The author gives an account of the gross anatomy and histology of the chromophil tissues in mammals, and especially in the dog. Descriptions and drawings of the groups of cells in the sympathetic ganglia and of the chromophil bodies in other regions are furnished, and comparisons are made between their structure and that of the adrenal medulla. An extract of the abdominal chromophil body of the dog has precisely the same powerful effect upon the blood pressure as an extract made from the medulla of the adrenal. There seems no reason why one cannot admit the hypothesis that all the chromophil cells have an internal secretion, though this process is more completely elaborated in the larger chromophil bodies and in the adrenal medulla.

Royal Anthropological Institute, April 12.—Sir Herbert Risley, K.C.I.E., president, in the chair.—S. Hazzledine **Warren**: Charcoal burning in Epping Forest. The industry was carried on near Chingford in 1908 and 1909, but has since been given up. The structure of the burners' hut was quite on prehistoric lines. The technical terms used by the burners are also survivals, many of them being Anglo-Saxon or French.—N. F. **Robarts** and H. C. **Collyer**: Additional notes on the British camp at Wallington. The authors described the excavations made when buildings were being erected on the site of the camp, no vestige of which was apparent until the ditch of the camp was cut through in the course of digging foundations, the whole area having at some time been levelled for cultivation. Numerous objects were exhibited which had been recovered from the ditch, including stone implements, mealing stones, loom weights, spindle whorls, and large quantities of pottery, including drinking cups and cooking pots, some of which contained charred grain. Some traces of bronze were found, including a bronze fibula, pointing to the date of the camp having been of early Iron age, possibly about 50 B.C. Some of the stone implements were considered to be of foreign manufacture, and although most of the pottery was very coarse, and probably made locally, a portion of it was evidently imported from Gaul. Particular attention was directed to some perforated tiles, which had apparently been used as "grids," one actually having been found lying near a cooking pot upon a hearth at the bottom of the ditch. Similar tiles had not previously been found in Great Britain. An amber bead showed probable intercourse with Scandinavia. In the ditch itself there was no trace of Roman or Romano-British pottery, although a small quantity of such ware was found in the humus which lay above the original land surface, and which had been washed or carried down by the plough from the higher ground. The authors considered that the camp had been destroyed or abandoned about the time of the Roman entry into London. The camp, which covered several acres, had apparently held a considerable population, which practised weaving and the potter's art, cultivated grain, and possessed, or at all events consumed, the ox and horse, the bones of which were associated with those of boar and wolf or dog.

Royal Meteorological Society, April 20.—Mr. H. Mellish, president, in the chair.—R. G. K. **Lempfert** and R. **Corless**: Line squalls and associated phenomena. A line squall is usually associated with the displacement of an air current moving from south-west by a colder current from north-west. The authors investigated the phenomena associated with several well-marked line squalls, and showed by maps with isochronous lines the direction of front and the rate of advance of the various storms across the country.

Linnean Society, April 21.—Dr. D. H. Scott, F.R.S., president, in the chair.—Miss M. G. **Sykes**: The anatomy of *Welwitschia mirabilis* in the seedling and adult stages. The development of the ridges bearing inflorescences has been studied. On the whole, the investigation has served further to confirm the impression of the aberrant nature of the plant; it may, indeed, be described as an "adult seedling."—Prof. P. **Stein**: Die von Mr. Hugh Scott im

uli 1908–März 1909 auf den Seychellen gesammelten nthomyidæ, mit den Gattungen Rhinia und Idiella.—)r. Malcolm **Burr**: The Dermaptera of the Seychelles.—)r. J. J. **Tesch**: The Pteropoda and Heteropoda collected y the Percy Sladen Trust Expedition in the Indian Ocean. -Dr. G. **Enderlein**: Die pilzmücken Fauna der Seyhellen.

Mathematical Society, April 28.—Sir W. D. Niven, resident, in the chair.—Dr. W. F. **Sheppard**: The ccuracy of interpolation by finite differences (second paper). -G. H. **Hardy**: Theorems connected with Maclaurin's test or the convergence of series.—Lieut.-Colonel A. **Cunningham**: Two notes on the theory of numbers, (i) the actorisation of $2^{77}+1$; (2) the indivisibility of 2^p-2 by p^3, being prime.

PARIS.

Academy of Sciences, April 18.—M. Émile Picard in the he chair.—The perpetual secretary announced the death of ulius Kühn, correspondant for the section of rural conomy.—Arthur R. **Hinks**: The solar parallax deduced rom micrometric observations of Eros made in 1900 and 1901. The final result of the micrometric observations is $\pi=8{\cdot}806''\pm0{\cdot}004''$. The results obtained by the method of passages are less exact.—M. **Giacobini**: Halley's comet. The comet was observed on April 17 at the Paris Observatory. Its present magnitude is between 2 and 2·5. The head of the comet is a circular nebulosity 30" to 35" in diameter, with a strong central nucleus, and no tail could be distinguished.—M. **Tzitzéica**: A new class of surfaces. —A. **Blondel**: The linear functional equation.—A. **Petot**: The mode of action of driving wheels.—C. E. **Guye** and H. **Schapper**: The internal friction of metals at low temperatures. The metals examined were copper, zinc, gold, nickel, palladium, and platinum, and the temperatures ranged from $+100°$ C. to $-195°$ C.—M. **Menneret**: The movements of a liquid in a tube. The damping of the oscillations of a liquid column in a **U**-tube follows two laws, according to the nature of the damping. Similar results are found in the uniform flow of a liquid in a rectilinear tube.—L. **Bloch**: Ionisation by the pulverisation of liquids.—MM. **de Broglie** and **Brizard**: Ionisation by bubbling and chemical reactions.—Louis **Dunoyer**: Concerning the formation of the kathode rays. In the production of the kathode rays the nature of the kathode is usually regarded as unimportant. An experiment is described in which the ordinary conditions of working are followed, and in which the nature of the kathode directly affects the phenomena obtained.—H. **Baubigny**: The constitution of the dithionates and sulphites. Dithionic acid is regarded as $HO_3.S—SO_3.H$, and sulphurous acid as $H.SO_3.H$, the evidence on which these formulæ are based being given.—E. **Fourneau**: The alkaloid of *Pseudocinchona africana* and its saponification by alkalies. The alkaloid of Pseudocinchona resembles yohimbine, and a comparative study of the two bases has therefore been made.—Marcel **Guerbet**: The constitution of the alcohols resulting from the condensation of the secondary alcohols, with their sodium derivatives. The oxidation products of the condensation product from capryl alcohol have been examined, and lead to the view that the alcohol is

$$CH_3.(CH_2)_5.CH(CH_3).CH_2.CH(OH).(CH_2)_5.CH_3.$$

—A. **Berg**: The action of silver oxide upon elaterine. The chief product of the reaction is a quinone, named elateridoquinone, acetic acid being also formed.—E. **Léger**: Aloinose, a sugar from aloin.—Léon **Brunel**: Cyclohexanetriols and their derivatives.—L. **Blaringhem** and Paul **Viguier**: A new species of shepherd's purse (*Capsella Viguieri*) produced by mutation.—Silvanus P. **Thompson**: The physiological effects produced by an alternating magnetic field. On placing the head inside a bobbin carrying an alternating current (field 1400 C.G.S. units) and closing the eyes, the effect of a feeble vacillating light is produced, the period of the fluctuation not being well defined.—A. **d'Arsonval**: Remarks on the preceding note by Silvanus P. Thompson. The phenomena noted have been known to physiologists since 1893.—Ch. **Dhéré** and M. **Gorgolewski**: A method of preparing a serum very free from electrolytes by electrical dialysis. By electrical dialysis the conductivity of the serum was reduced to one-twelfth of its original amount. The purified serum was very readily precipitated by the addition of small amounts of alcohol; the temperature of coagulation was much lower for the purified product.—E. **Bataillon**: Complete embryogenesis produced in Amphibia by the puncture of the virgin egg. The eggs of *Rana fusca* were punctured with a short stylet of glass, manganin, or platinum, the size of the hole being from 0·03 to 0·08 mm. Segmentation started in the treated eggs as rapidly as in eggs impregnated in the ordinary way. A dozen free larvæ resulted from nine sets of operations.—J. **Bridré** and L. **Nègre**: The nature of the parasite of epizootic lymphangitis. The experiments described favour the hypothesis of the blastomycelian nature of the parasite.—E. **Lesné**, R. **Debré**, and G. **Simon**: The presence of virulent germs in the atmosphere of hospital wards. Diphtheria bacilli were proved to be present in the air of the diphtheria wards.—F. **Garrigou**: A rapid and certain method for recognising in a mineral water the presence of metalloids and metals.

April 25.—M. Émile Picard in the chair.—H. **Deslandres**: The distribution of the filaments in the upper layer of the solar atmosphere. The observations taken at the Meudon Observatory now include photographs of the upper layer for twenty rotations with the calcium line and fourteen with hydrogen. The observations are discussed in detail, and four diagrams given showing the filaments on May 20, June 15, November 27, 1909, and April 11, 1910. The observations may throw light on the distribution and special variations of the protuberances, at the present time not regarded as connected with any other solar phenomena.—A. **Haller** and A. **Lassieur**: Study of by-products from cocoa-nut oil. The composition of essence of cocoa. In the purification of commercial cocoa-nut oil by treatment with superheated steam a distillate is obtained smelling strongly of oil of rue. From this mixture a ketone, $C_{11}H_{22}O$, has been isolated. The oxime and semicarbazone are described, and the oxidation products studied. The ketone was shown to be normal methylnonyl ketone. Methylheptylketone was also obtained from the fractions of the crude oil.—C. Eg. **Bertrand** and F. **Cornaille**: The characteristics of the botryopteridian leaf trace.—Ch. **André**: The effect produced on hailstorms by the hail cannon. A statistical study of the effect of hail cannon. Comparing the damage done by hail over the years 1901 to 1908, and the number of hail cannon installed during that time, the conclusion is drawn that no practical service is rendered by the cannon.—P. **Lowell**: A new method of planetary photography employed at the Lowell Observatory at Flagstaff, Arizona. The method was devised by Lampland, and improved by E. C. Slipher. A special screen is used in association with suitable plates, so that the yellow rays near the D lines are the only ones to act on the plate. Details of the results obtained with Jupiter and Saturn are given.—C. **Russyan**: The integration of a system of partial differential equations of the first order by the generalised method of Jacobi.—Joseph **Marty**: The existence of singular solutions for certain equations of Fredholm.—Michel **Fekete**: The series of Dirichlet.—M. **Ouivet**: An application of birational transformations.—H. **Vergne**: The canonical changes of variables.—B. **Galitzine**: The precision of apparatus serving to study the vibration of buildings. In the immediate neighbourhood of a Diesel motor the vertical vibrations predominate, but in a building some distance away both the vertical and horizontal movements are of the same order of magnitude. The vibrations are greater in the higher storeys of a building than in the lower.—U. **Schoop**: A new principle of depositing metals. The fused metal is turned into a fine dust and projected on to the surface to be covered by means of an indifferent gas, hydrogen or nitrogen, under high pressure. A sort of metallic fog is produced, which, in spite of the high temperature of the fused metal, has usually a temperature of between 10° C. and 60° C. Tin, lead, copper, and aluminium alloy, all of which are very fluid when fused, can be deposited on wood, glass, metal, and other surfaces, the thickness of the deposit being completely under control. —C. **Chéneveau**: A simple arrangement for measuring a magnetic field. A differential manometer containing a paramagnetic liquid (an aqueous solution containing 30 per cent. of manganese sulphate) and a diamagnetic liquid of approximately the same density not miscible with the first

(a mixture of benzene and carbon tetrachloride) is placed in the magnetic field the strength of which is to be measured. The boundary meniscus of the two fluids is displaced in the field and is brought back to the original position fixed by a cross-wire in a microscope by the compression of an air bulb. The pressure required to do this is measured on a separate differential manometer. A field of 2800 units gave a reading in the manometer of 65 mm. —P. **Vaillant**: A law of Stefan relating to evaporation. —H. **Ollivier**: The spontaneous re-magnetisation of iron. —P. **Pascal**: The measurement of the magnetic susceptibilities of solid bodies. The solid is placed in a thin glass tube in the magnetic field suspended from the arm of a sensitive balance. By replacing the solid by water a formula is derived giving the magnetic susceptibility independent of the nature and dimensions of the apparatus. —M. **Pariselle**: The ethyl ether of allylcarbinol. This substance has been obtained by the interaction of allylmagnesium bromide and monochlor-methyl-ethyl ether. The products obtained by the addition of bromine and hypochlorous acid have been studied.—Mlle. Pauline **Lucas**: The action of organomagnesium derivatives on the trialkylacetophenones.—Marcel **Delépine**: The essence from *Crithmum maritimum*.—J. **Bertheaume**: The chlorplatinates and periodides of dimethylamine and trimethylamine: their use for the separation of these bases. Determinations of the solubilities of the chlorplatinates of these two bases showed that the differences were too slight to be used as a basis of separation. The method of separation proposed by Weiss, based on the differences of solubility of the periodides, proved to be equally unsatisfactory. —H. **Agulhon**: The influence of the reaction of the medium on the formation of melanines by diastatic oxidation.—J. **Chevalier**: Variation in the amount of sparteine in the plant according to the period of its vegetation.—Léon **Marret**: The presence of Alpine plants at low altitudes in the central Valais.—J. **Beauverie**: The Ambrosia of *Tomicus dispar*.—H. **Colin** and J. **de Rufz**: The absorption of barium by plants. The barium absorbed by plants was found to be localised in the roots.—Gabriel **Vallet**: The sterilisation of large quantities of water by means of the ultra-violet rays. A water polluted with coli bacilli was exposed to ultra-violet light produced by the expenditure of 0·4 kilowatt-hour in a quartz mercury vapour lamp. The water was passed at the rate of 10 cubic metres per hour, and the conditions for complete sterilisation are laid down.—E. **Sauvage**: The abdominal part of the great sympathetic in Saurians.—A. **Ricco**: The eruption of Etna of March 28, 1910.—L. **Joleaud**: The evolution of Quaternary hydrography in the Constantine region, Algeria.—Albert **Nodon**: Researches on the ionisation of the hot spring of the thermal waters of Hammam-Salahin, near Biskra.

DIARY OF SOCIETIES.

THURSDAY, May 5.

Royal Society, at 4.30.—The Development of Trypanosomes in Tsetse Flies: Col. Sir D. Bruce, C.B., F.R.S., Captains A. E. Hamerton and H. R. Bateman, R.A.M.C., and Captain F. P. Mackie, I.M.S.—On the Weight of Precipitate obtainable in Precipitin Interactions: Dr. H. G. Chapman.—The Absorption of Gases by Charcoal: Miss I. F. Homfray.

Royal Institution, at 3.—Blackfeet Indians in North America: Walter McClintock.

Röntgen Society, at 8.15.—Quantitative Measurements of the Conversion of Kathode Rays into Röntgen Rays by Antikathodes of Different Metals: J. H. Gardiner.

Institution of Electrical Engineers, at 8.—A Telephone Relay: S. G. Brown.

Linnean Society, at 8.—Eight Months' Entomological Collecting in the Seychelles Islands: Hugh Scott.—The Anatomy of *Tipula maxima*: J. M. Brown.

FRIDAY, May 6.

Royal Institution, at 9.—Auto-inoculation: Sir Almroth E. Wright, F.R.S.

Geologists' Association, at 8.—The History of the Study of Fossils: Dr. A. Smith Woodward, F.R.S.

SATURDAY, May 7.

Royal Institution, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

MONDAY, May 9.

Royal Geographical Society, at 8.30.—The Land of the Incas: Sir Clements R. Markham, K.C.B., F.R.S.

Victoria Institute, at 4.30.—Annual Address. Halley's Comet: Dr. A. C. D. Crommelin.

TUESDAY, May 10.

Royal Institution, at 3.—The Mechanism of the Human Voice: Prof. F. W. Mott, F.R.S.

WEDNESDAY, May 11.

Royal Society of Arts, at 8.—The Restoration and Discoveries at the Guildhall, London: S. Perks.

Geological Society, at 8.—Dedolomitization in the Marble of Port Shepstone, Natal: Dr. F. H. Hatch and R. H. Rastall.—Recumbent Folds in the Highland Schists: E. B. Bailey.

THURSDAY, May 12.

Royal Society, at 4.30.—*Probable Papers*: The Influence of Bacterial Endotoxins on Phagocytosis (Preliminary Report): Leonard S. Dudgeon, P. N. Panton, and H. A. F. Wilson.—The Origin of Osmotic Effects. III. The Function of Hormones in Stimulating Enzymic Change in relation to Narcosis and the Phenomena of Degenerative and Regenerative Change in Living Structures: Prof. H. E. Armstrong, F.R.S., and E. Frankland Armstrong.—On the Direction of Motion of an Electron ejected from an Atom by Ultra-violet Light: Dr. R. D. Kleeman.

Royal Institution, at 3.—Blackfeet Indians in North America: Walter McClintock.

Institution of Electrical Engineers, at 8.—Street Lighting by Modern Electric Lamps: H. T. Harrison.

Mathematical Society, at 5.30.

FRIDAY, May 13.

Royal Institution, at 9.—Radio-activity as a Kinetic Theory of a Fourth State of Matter: Prof. W. H. Bragg, F.R.S.

Royal Astronomical Society, at 5.

Malacological Society, at 8.—Mollusca of the *Porcupine* Expedition, Part IV.: E. A. Sykes.—The Genus Cremnobates, Swainson: C. Hedley and H. Suter.—Notes on Polyplacophora, chiefly Australasian, Part II.: T. Iredale.—Notes on and additions to the Terrestrial Molluscan Fauna of Southern Abyssinia: H. B. Preston.

SATURDAY, May 14.

Royal Institution, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

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THURSDAY, MAY 12, 1910.

THE DEATH OF THE KING.

KING EDWARD THE SEVENTH is no more. An Empire is in mourning. The death of the King has come with a suddenness which has stunned his people, who, however, have already given no uncertain signs of the deep love and respect they entertained for a ruler who always strove to do his duty. Her Majesty the Queen-Mother and the other members of the Royal Family know full well that they are not the only mourners, and that the sympathy of millions in the widest Empire the world has known, and others outside it, is extended to them in their personal loss.

We can answer for it that the grief of the leaders and students of science in the realm is as deep as that of any of their fellow citizens. They do not forget that the late King was the son of the Prince Consort, one of the highest products of the German university system, in which science always finds a place, through whose influence the importance to this nation of the study and fostering of science and art was first recognised, and whose early death, it has been said, was more harmful to Britain than the loss of a great campaign. With such a wise father it is not to be wondered at that the late King began his university studies by attending Playfair's lectures on chemistry (in 1861) when he was twenty years of age. For this reason, again, it is not to be wondered at that among the innumerable public duties the King performed since, as Prince of Wales, he opened the great railway bridge across the St. Lawrence at Montreal, many of those in which he exhibited the keenest interest have had to do with the opening or extension of institutions connected with science.

If there were anything like a complete organisation of science in England, we may be certain the King's interest in it, great as it was, would have been greater still. The organisation of science means a scientific department of the State; this means a Minister of Science in the immediate entourage of the sovereign.

How much we might have gained, great though the late King's work in this direction has been, we can gather from what has been accomplished by the King's actions in scientific matters on which he was kept informed and interested, not by a Minister of State, but by the eminent representatives of medical science attached to his person.

Since the late King's accession to the throne it may be said that the enormous expansion and amelioration of everything that has to do with the healing of sickness and the lessening of all the ills which follow on it are mainly due to his unceasing efforts to secure a better organisation of hospitals and of the nursing staff throughout the land.

In the various addresses which the late King delivered during a period of forty years before his accession to the throne, and since, on the occasions of the calling into being of new English colleges and universities, and on other similar functions, the note of the importance of the advancement of science to the nation was almost invariably struck. On one of the last public appearances of this nature, that of laying the first stone of the new buildings of the Imperial College of Science and Technology, in July of last year, the King said:—"In recent years the supreme importance of higher scientific education has, I am happy to say, been fully recognised in England; and as time goes on I feel more and more convinced that the prosperity, even the very safety and existence, of our country depend on the quality of the scientific and technical training of those who are to guide and control our industries." This and other similar utterances have shown that in the late King science had a firm friend, and that his action for good would have been greater still if representatives of science were to be found among the King's ministers.

Although it is incumbent upon us to refer chiefly to the late King's activities and marks of sympathy in scientific directions, we must at the same time point out his vast services to the nation in other, almost innumerable, ways. An ardent apostle of peace, the whole world was his debtor; and not science alone has gained by his anxiety to foster the arts of peace by honouring those engaged in their pursuit.

In past times only national services in war were distinguished by the sovereign's mark of approval; King Edward did not hesitate to confer marks of honour upon the most eminent representatives of science, art, literature, commerce and industry. We owe to him the foundation of the Order of Merit, the highest

and rarest distinction for State service which now exists, and it is an honour to the few men who hold it that a woman, Miss Nightingale, belongs to the Order.

With regard to his present Majesty, King George the Fifth, to judge of what he has done as Prince of Wales, we may feel sure that there will be no falling off from the strenuous life of public duty exhibited by his father and grandfather.

We are informed by those who have had the privilege of conversing with him that, as one of the effects of his education as a naval officer, for the education of a naval officer must be scientific, he is fully in sympathy with those who insist upon the importance of science as one of the foundations of the greatness of a nation. It was this interest in science which caused him to regret deeply his inability to accept the presidency of the British Association at its meeting in South Africa. State duties had called him to India at that time.

King George is unapproached as a traveller, among crowned heads, whether of his own or of previous time. The new sovereign has probably seen more of the Empire than has been traversed by any single person among all his subjects. After the Australian Commonwealth was inaugurated, the King and Queen journeyed fifty thousand miles by land and water. They returned to Canada for the great tercentenary pageant at Quebec and the consecration of the battlefields, and meanwhile, in 1905, they had put a girdle round the globe again and traversed India from the Khyber to the Ganges, and from the Himalayas to the temples of the South. It has been well said that not one of his subjects realises better than the King how little is known of England by those that only England know, or how inseparably the whole life and fortunes of this island are knitted up with the destinies of the outer Empire. That many of the national shortcomings to which it is our duty to refer from time to time are fully known to his present Majesty is proved by his famous warning, uttered after all his journeyings, "Wake up, England."

In the midst of the nation's grief at a loss so great and so sudden that there has not been time to realise it, comfort may be found in the assurance which we possess that in the future, as in the past, the illustrious Royal Family will guard the best interests of our Empire. They will thus retain the affection and respect of a grateful people, whose hearts now go out to them in profound sympathy with their sorrows.

EDITOR.

THE NEW "ORIGIN OF SPECIES."

The Mutation Theory. Experiments and Observations on the Origin of Species in the Vegetable Kingdom. By Hugo de Vries, Professor of Botany at Amsterdam. Translated by Prof. J. B. Farmer and A. D. Darbishire. Vol. i., The Origin of Species by Mutation. Pp. xv+582. (London: Kegan Paul and Co., Ltd., 1910.) Price 18*s*. net.

THE two smaller books by Prof. de Vries written in English have already put us in possession of a clear account of his theory of the origin of species by discontinuous variation. The publication of a translation (of which this is the first volume) of his larger "Die Mutationstheorie" will be valuable to students as containing the detailed arguments upon which it is based.

De Vries has long been known as a distinguished physiologist who has the advantage of a sound training as a physicist. Now a physicist, in attacking a problem, endeavours to get it into the simplest form which admits of experiment and measurement. Having obtained a "law" which fits his results, he proceeds to test its application to more complicated phenomena. But "life" is a complex which at present defies analysis, and the naturalist is therefore obliged to survey organised nature as a whole, and to endeavour to extract from its observation principles of general application. In this way organic evolution has been arrived at, for it is now generally admitted to find its securest basis in the evidence afforded by palæontology of the succession of living forms in the past history of the earth. It might also, though less convincingly, find it in the facts of geographical distribution. Darwin did not invent evolution, but he made it immensely more acceptable, first by breaking down the old belief in the constancy of species, and, secondly, by giving, in "selection," a mechanical explanation of how they came into existence.

To this de Vries raises the same objection as Huxley, though on different grounds, that "we do not observe actual specific changes in nature" ("Plant Breeding," p. 4). His object is to overcome this difficulty. He agrees (p. 207) that

"we have a doctrine of descent resting on a morphological foundation. The time has come to erect one on an experimental basis."

In this he believes he has succeeded. Every-

one must admire the patience and enthusiasm which he has brought to the task, and if the naturalist must be permitted to criticise the result from his point of view, he cannot but approve the scrupulously fair and instructive way in which de Vries has published every detail of his research.

In order to do justice to the theory which de Vries has founded on his observations, it is necessary to attach some precise meaning to the technical terms used. Darwin was nothing if not a naturalist. It is impossible to read de Vries's pages without feeling that he is not quite at his ease with the naturalist's technique. On p. 21 I find, for example, the following statement:—

"It is most remarkable that in the 'Index Kewensis,' which was published at Darwin's expense after his death, no distinction is drawn between varieties and synonyms."

I do not suppose it was intended, but this might be construed to mean that the work as executed failed to carry out Darwin's intention. That this would be the reverse of the fact I can state with confidence, as the plan was discussed and settled between Mr. Darwin and myself in his own house. What he told me he wanted was to be able to trace to its source any specific name that he met with. This the "Index" does, and it is an incalculable boon to those who use it. But its purpose is merely bibliographical, and it was not intended to express any opinion as to the validity of the species which it catalogues; nor was there ever any suggestion that it should catalogue varietal names.

It would be quite possible for a discussion of de Vries's theory to evaporate into a mere logomachy, a mere dispute as to the meaning of words. That I hope to avoid, but if I fail, he himself will have to share the blame. The word "mutability," which is peculiarly de Vries's property, and, indeed, contains the kernel of his theory, is an example. So far as I can find, it does not occur in Darwin's writings. Yet on p. 202 I find the following summary of the Darwinian theory:—

"Mutability may take place in almost all directions; and it is natural selection which operates in one direction during long geological periods";

and that there may be no mistake, he adds that this "obviously represents the view of Darwin." This is emphasised on p. 198, where "species-forming variability" and "mutability" are treated as synonyms. But de Vries's whole contention is that, in the ordinary acceptance of the terms, they are profoundly different. This is apparent from the following passage in the author's "Plant Breeding" (pp. 5-6), a book which, I confess, seems to me to be written with more precision that the larger one.

"The phenomena that follow Quetelet's law are now considered as one group, which is called fluctuating variability or fluctuation, since the individual qualities fluctuate around their average. The processes by which new qualities are produced must be studied separately. Under the assumption that these processes are neither slow nor invisible, but consist in leaps and jumps such as are popularly indicated by the name of sports, they are now called mutations, and the great subdivision of the phenomena of variability is designated, in consequence thereof, as mutability."

Now there is no want of precision about this statement. It of course assumes the very point which has to be proved, that "fluctuating variability" does not produce "new qualities"; but that is another story.

De Vries has elsewhere employed the words continuous and discontinuous, as descriptive of the two processes. Unfortunately, Bateson used these at the same time in a different sense, and this has added another pitfall to the discussion of the subject. At first sight we seem to have a sharp distinction between the theories of Darwin and of de Vries, the one accounting for the origin of species by the accumulation of small variations, the other by "sports." If we take, as an example of the latter, the production of the nectarine from the peach, there can be no doubt that the leap may be considerable. While the occurrence of sports is undeniable, de Vries appears to draw a distinction between the part attributed to them by Darwin and Wallace in the production of species (pp. 12 and 39). Wallace regards them "as absolutely without significance" (p. 40). But Darwin, with more caution, doubts whether they "are ever permanently propagated in a state of nature" ("Origin," fifth edition, p. 49), and this is practically the same thing. De Vries himself is led gradually to minimise their magnitude. He finds (p. 53) "sports" "not a happy" term, and prefers "jerky variability" where "jerks may only induce quite small changes." Later on he finds (p. 55) that "many mutations are smaller than the differences between extreme variants." He quotes Galton's polyhedron which, when disturbed, "oscillates round its position of equilibrium" (fluctuation), and finally "comes to lie on a new side" (mutation). But when the faces are very small, the illustration is obviously not helpful; when the variation is very small, the distinction between the two kinds is inappreciable.

To meet this difficulty, de Vries sets up other criteria. These he has drawn from a mass of experimental work for which it is impossible to conceal one's admiration, and is a positive addition to our knowledge. But it is, of course, permissible to draw from it somewhat different conclusions. "Mutants" arise without transitional forms (p. 248). It appears, however (p. 504), that such do occur, but simultaneously, and not before; the mutants, therefore, are artificially selected from a varying population. But they possess from the first absolute stability; this is an extremely interesting point; it is, of course, implied that they were self-fertilised, and that the conditions were unchanged. It is, however, to be noticed that it was not universally the case, as three of the mutants studied "proved to be inconstant," and some actually reverted to the original parent (p. 508). Such mutants he calls "elementary species," a term for which he invokes (p. 57) the authority of Darwin, who, however, only said that "varieties are incipient species," a very different thing.

It follows that "specific characters are absolutely

independent of selection" (p. 90); "by natural selection species are not *created* [no one ever thought they were], but eliminated" (p. 199). Selection "now has served its time as an argument for the 'Theory of Descent'" (p. 29). It was, indeed, finally disposed of by Lord Salisbury (p. 70), a fact which would have more weight if he had not ludicrously misapprehended the Darwinian theory.

The utility of specific characters (p. 65) and adaptation necessarily go by the board as well. Desert plants are not adapted to desert life. "They endure the desert, but only with difficulty" ("Plant Breeding," p. 350); "the spurs of the orchids . . . have not been originated in the way in which plants are now using them" (*l.c.*, p. 352). It must be admitted that all this is perfectly consistent, and follows logically from the conception of the species as an arbitrary result, "independent of the environment," and for which "we can as yet assign no cause" (p. 130). This makes a pretty complete sweep of the Darwinian theory, and practically takes us back to the position of Linnæus, who was content to suppose that species were created. It must, however, be put to de Vries's credit that he makes an heroic attempt to save Darwin himself from the wreck by claiming him as at heart a mutationist (p. 87) who "only by the pressure of criticism" (p. 39) gave up the true faith. There is a little irony in the fact that, as the critic was apparently Fleeming Jenkin (p. 37), the mischief was the work of a physicist. The attempt, though generous, is scarcely convincing, and so Darwin goes, and with him goes the splendid and fertile field of biological research for which he opened to us the door. Its place is taken by the procession of arbitrary mutants which have nothing to tell us because they have nothing to say. It is a rather dreary outlook, only mitigated by the "hope that we may be able to gain some control over the formation of species" (p. 186). Yet when I turn to Darwin and read "We have no evidence of the appearance, or at least of the continued procreation, under nature, of abrupt modifications of structure" ("Variation," ii., p. 414), I pluck up a little conviction of something that seems more full-bodied than a mere echo of Fleeming Jenkin. It may be remarked, however, that the celebrated argument of the latter has never been refuted.

I do not know whether to take comfort from the fact that if Darwin fares badly, Lamarck fares worse.

"Specific characters are never 'acquired'; and there is no need for taking 'acquired characters' into consideration in the whole domain of comparative biology and the theory of descent" (pp. 130–1).

That gets a troublesome question out of the way, at any rate. To finish clearing the ground, a last dictum:—"No theory of the origin of species can have any bearing at all on this subject" [sociology] (p. 159). "Man is immutable albeit highly variable" (p. 156), a reservation with little satisfaction, as de Vries will allow no stability to racial variation.

It may be asked, on what are these sweeping conclusions based? Bateson inferred the discontinuity of variation from the observed discontinuity of species. De Vries apparently does not accept this, but for once adopts the obvious Darwinian explanation, "Subspecies become species by the extinction of intermediate forms" (p. 186). His own theory is based on the prolonged study of a single species of unknown and suspect history. It is, perhaps, one of the most remarkable cases in science of generalisation from a single instance, and that highly dubious.

He commences the account of his experimental work by remarking (p. 217):—

"The chief obstacle in the way of . . . investigating the origin of species is our complete ignorance of the conditions under which the process takes place."

To test it, he "brought over one hundred species into cultivation" from the neighbourhood of Amsterdam. "Only one of these turned out to be what I really wanted." He does not tell us in what respect they failed, but concludes that mutability occurs "relatively rarely." It seems, therefore, to be open to the same kind of objection as has been urged against natural selection, that it "will generally act," as Darwin said, "very slowly, only at long intervals of time" ("Origin," sixth edition, p. 85). I think it is clear that what baffled de Vries was specific stability. It takes a somewhat prolonged subjection to cultural, *i.e.* changed, conditions to break this down. I have given numerous instances in these pages of extremely stable species which ultimately broke down. I have watched the process at Kew in *Primula obconica*, which now produces flowers two inches across. The process was described by Vilmorin half a century ago:—"The fixed character of the species being once broken, the desired variation will sooner or later appear" (Darwin, "Variation," ii., p. 262). I cannot doubt, therefore, that if de Vries had had patience, every one of his hundred species would have become plastic in his hands.

He, then, has been obliged to rest his theory on a single case, that of *Œnothera lamarckiana*. There is no evidence that this is a "natural species." It made its appearance in the Paris Jardin des Plantes, and, as pointed out by Lock and Boulenger, de Vries's results are open to the interpretation of being simply due to "Mendelian disjunction."

But, waiving this point, there is a graver difficulty. De Vries insists (p. 130) that his mutations are "independent of the environment." A moment's reflection will show the disadvantage under which his theory rests in this respect compared with that of Darwin, which provides a means of automatic and continuous equilibrium, and remorselessly eliminates whatever fails to adjust itself to it. De Vries admits (p. 199) that his mutations must submit themselves to selection; but they are so handicapped at the start that they can rarely have much chance, and this is confirmed by the inability of sports to hold their own in nature. Even *Œnothera lamarckiana*, whatever it may do under cultivation, does not appear to be able to produce permanent varieties under natural conditions.

Two other lines of argument require brief examination. De Vries points to the familiar little crucifer, *Draba verna*, which is now in flower everywhere, as a case of natural mutation. Jordan collected from

different countries some two hundred forms, differing often in extremely minute characters, but which he and other observers found to be stable in cultivation. Most systematists regard them as mere varieties. But species are only the stable forms of diverging races, the connecting links between which have disappeared. A naturalist will unite in one species in the Linnean sense, as in the case of *Draba verna*, a range of forms where it is conceivable that the differences could be bridged by continuous variation. Darwin thought that such forms might be stable, as, indeed, they appear to be. They may, in fact, be regarded as adjusted to slight differences in the environment, a view which derives some confirmation from the fact, which I confess surprised me, that de Vries finds only one of the two hundred forms of *Draba verna* in the neighbourhood of Amsterdam. This view would, of course, be rejected by de Vries, who looks upon them by analogy as mutants. The Darwinian explanation equally rests on an analogy, the production of the races of cultivated plants by artificial selection.

De Vries feels the force of this, and it is therefore essential to his case to break down the analogy. He admits (p. x) that "the process of selection has enabled us to produce improved races." But he draws a curious distinction between horticultural and agricultural methods. "In horticulture, varieties arise by mutations. . . . In agriculture, the highly improved races arise gradually through selection" (p. 82). For my part I am quite prepared to admit that mutation has had some share in the production of the latter; and as to the former, de Vries quotes my own observations on *Cyclamen latifolium*, where there can be no doubt that the existing race is the result of continued selection. The distinction, in fact, cannot be sustained.

De Vries objects to any argument drawn from cultivated races. We know little usually of their origin (pp. 13, 14), and this is true; they are often of hybrid origin (p. 75), which is equally true; both objections, it may be noticed, have been urged against his own Œnothera; finally, "improved races" (unless arising by mutation) lack stability (p. 120). This has been fully discussed by Darwin, and both he and Sir Joseph Hooker insist "on what little evidence this belief rests" ("Variation," ii., p. 32). Such races are the result of artificial selection, and are only stable under artificial cultural conditions. If these are withdrawn a new adjustment has to be sought, and, as Wallace has pointed out, in the face of competition for which they are in no way fitted. As Darwin says, "to assert that we could not breed our . . . esculent vegetables, for an unlimited number of generations, would be opposed to all experience" ("Origin," fifth edition, p. 16). The fact is accepted in the law courts, and if a pea such as Veitch's Perfection did not come true from seed, the purchaser would have a cause of action against the vendor.

De Vries states (p. 124) that "fruit-trees grown from seed quickly revert to the original type." This is too extreme a statement. The measure of truth in it is easily accounted for. Stability can be obtained in races where seminal reproduction can be quickly repeated. But a generation of fruit trees approximates to that of mankind, and though, theoretically, stability might be obtained, it would require a Methuselah to do it.

De Vries prefaced the first edition of this book by remarking that "The origin of species has so far been the object of comparative study only." It must always be to his credit that he has been the first to submit it to experiment. If the results seem so far inconclusive, the method, in the long run, must be fruitful. Darwin deliberately relied on continuous variation, de Vries relies on discontinuous. It must be obvious that the former has been a potent solvent of a wide range of biological problems where de Vries leaves us without an answer; and he frankly admits that on the fundamental principle we are as much in the dark as ever. For mutations, "we can as yet assign no cause" (p. 130), though (p. 207) he suggests that "the opportunity for the appearance of mutations is at once given" by change of environment. Beyond this we are no wiser as regards one kind of variation than as regards the other. We are evidently a long way from that "control of the mutative process" which "will, it is hoped, place in our hands the power of originating permanently improved species" (p. x).

W. T. THISELTON-DYER.

PHYSICAL SCIENCE IN THE TIME OF NERO.

Physical Science in the Time of Nero; being a Translation of the "Quaestiones Naturales" of Seneca. By J. Clarke, with notes on the treatise by Sir Archibald Geikie, K.C.B., P.R.S. Pp. liv+368. (London: Macmillan and Co., Ltd., 1910.) Price 10s. net.

THE genius of the Roman people was mainly for action, conquest, and organisation. In the realms of thought they made but few original advances, here showing a striking contrast to the Greeks, whose progress in civilisation some few centuries previously had been intellectual rather than material, and made in art, philosophy, and speculation as to the deeper problems of life and nature. Of course, western nations owe, and have owed, an immense debt to the intellectual advances made by the Greeks, and there seems little danger that this debt will ever be underestimated. But there is reason to fear that full justice may not be done to the scientific progress made by the Romans; and Mr. Clarke's admirable translation of Seneca's "Quæstiones Naturales" comes very opportunely to illustrate its extent.

As Mr. Clarke points out in his introduction, Lucius Annæus Seneca was an exceptionally able man of many aptitudes—rhetorician, advocate, philosopher, author, politician, and for fifteen years tutor first and latterly also *âme damnée* to that monster of iniquity, the Emperor Nero. During his lifetime Seneca must have been best known for his eminence as a politician; during the many years when he was out of imperial favour, and had no share in politics, he devoted himself to philosophy, science, and authorship. As a philosopher he illustrates the eclecticism

of the Stoics, particularly in ethics. It was in ethics that his deepest interest lay. Even in a physical treatise like the "Quæstiones Naturales," he often breaks off a scientific discussion in order to improve the occasion by an outburst of orthodox morality *à la* Mr. Barlow, in which he chastens the excesses of the fashionable society of his day with a gusto that vividly recalls the sermons of a modern fashionable preacher, and with all the energy of an itinerant tub-thumper. In fact, so pure is his puritanism, so moral the morality of his denunciations, that one is almost tempted to disbelieve the known facts of his biography. But if his Stoicism is thus perhaps suspect, no similar accusation can be brought against his honesty as a man of science. "There is considerable internal evidence in the 'Quæstiones Naturales,'" says his translator, "that his pursuit of such studies was in part an outcome of the true scientific spirit, and that he possessed in no ordinary degree the scientific imagination." He was also an eclectic in his views about the material world, believing it to be built up out of the four elements—fire, air, earth, and water—of Empedocles, Plato, and Aristotle. But he rejected the fifth Aristotelian element, οὐσία, the immaterial *quinta essentia* so misconceived by mediæval philosophers, and he did not hesitate to part company with the Stoics whenever he felt inclined to disagree with their views. Of training as a man of science Seneca had none, for none was available in his day.

No doubt the "Quæstiones Naturales," or "Physical Inquiries," were written about and after the year 60 A.D., not long before Seneca's suicide was ordered by Nero; they are in a semi-epistolary style, and dedicated to his friend Lucilius. Their text has suffered much in the process of transmission through the ages; none of the MSS. is earlier than the twelfth century, and much ingenuity has been exercised by their editors (most recently by Prof. Gercke, of Breslau) in rearranging the various portions of the work into the order and form in which Seneca may be supposed to have left them. Originally the work consisted of eight books, two of which, probably ii. and iii., have now become fused into the present book iv. Most of it is taken up with meteorological questions, and consists of discussions as to the nature of meteors, the rainbow, thunder and lightning, winds and the atmosphere, snow, hail, and rain. One book is devoted to the forms of water, another to earthquakes, a third to comets. Seneca's general method is to state what is known or asserted about the phenomenon he is describing, and to give a critical discussion of the explanations—for it is chiefly in the explanations that he is interested—it has received, and, finally, to state and establish his own view about its causation.

The science of the ancients rarely advanced beyond the rudimentary stages for two main reasons. The first is the difficulty they always had in understanding that accurate observation and reasoned experiment were either necessary or desirable. The second is the facility with which their nimble minds sought refuge from this hard world of facts in speculation. To them a theory was as good as a fact, and a theory weighted with the authority of some great philosopher was better than many facts. The chief merit of Seneca as a man of science lies in his recognition of the importance of observation, and of the use of common sense in the interpretation of the observed facts of nature. It is true that many of his observations were faulty, many of his explanations were based on false analogy, many of his arguments are illogical or even ridiculous when viewed in the light of modern knowledge; but in these matters he merely suffered from the disabilities of his age, and his shortcomings are not to be too hardly judged.

The style of the "Quæstiones Naturales" is that of the polished orator and rhetorician. Seneca addresses Lucilius directly, and in the heat of argument he often sets up and argues with scientific men of straw whose duty is to advance views foredoomed to demolition. The text, as we have seen, is full of uncertainties and corruptions, but it has been very happily treated by its translator. The English version is most readable, and gives a first-rate reproduction of the varied style, the oratorical questions, the irony, the sarcasm, the occasional poetic afflatus, with which Seneca animated what might have been in other hands a heavy didactic exegesis. Mr. Clarke's skill as a translator is particularly evident in the success with which he has broken up into reasonable fragments the often long and involved sentences of the Latin original. Again, Seneca's habit was to employ important words—"aer" and "spiritus," for example—in several different senses, and, conversely, to express a single idea, such as that of the atmosphere, by a variety of different words in different contexts. The translator appears to be singularly successful in conveying what was Seneca's real meaning in these numerous and difficult passages. In conclusion, it may be added that Sir Archibald Geikie's valuable notes, which take the form of a running commentary on the seven books, and are given at the end of the translation, are of great assistance in the appreciation of Seneca's attainments and limitations. They are written from the point of view of modern science, and do much to show how and why he so often fell into scientific error. The book is well got up and indexed, and may be cordially recommended to all who are interested in Seneca, in the art of translation, or in the history of science.

A. J. J.-B.

THE STUDY OF IMMUNITY AND ITS PRACTICAL APPLICATIONS.

Immunity and Specific Therapy. By Dr. W. d'Este Emery. Pp. xiv+448. (London: H. K. Lewis, 1909.) Price 12*s*. 6*d*. net.

THE amount of literature bearing on immunity and on the specific therapy of infective diseases which has appeared during the last few years is so great that it is difficult, even for the "specialist," to keep pace with its production. Reviews and summaries on the subject are therefore very needful, and the publication of Dr. Emery's work is opportune.

The book surveys almost the whole field relating to immunity—microbial toxins, antitoxins, bacterio-

lysis, agglutinins, precipitins, phagocytosis, and immunity to bacteria—and though perhaps somewhat more full of detail than the needs of the medical practitioner require, will be of great value to the pathologist and bacteriologist. The subject is dealt with critically and judicially, the various hypotheses are presented to the reader, and divergent views are stated fairly.

The opening chapter of the book gives a good general account of the essentials of immunity. One point we are glad to see the author brings out, viz. the ill effects to the patient of prolonged anæsthesia in surgical operations. It does not seem always to be appreciated that the power of recovery of a patient is, to say the least, jeopardised when anæsthesia is prolonged beyond a certain time.

The account of the interactions between toxin and antitoxin (chapter iv.) contains a clear statement of the hypotheses of Ehrlich, Arrhenius and Madsen, and Bordet, and is concluded with the judicial summary that

"No theory is absolutely sufficient to explain all the phenomena, and soon after each new one is adduced the supporters of the older ones bring forward evidence which renders it untenable. The probability is, at the time of writing, that Ehrlich's views are generally held, and are open to the fewest objections. They are complicated, it is true, and have had to undergo constant modifications as new facts have arisen; but the facts themselves are complicated. Yet it must be confessed that there are some grave objections to its acceptance in its present form, and it may become yet more involved before it can be fully accepted as a complete explanation" (p. 91).

The summary of Ehrlich's "side-chain" hypothesis of the formation of antitoxin (chapter v.) is excellent. Incidentally the definition of a "proteid" is dealt with, and it is suggested as a logical outcome of Ehrlich's hypothesis that proteids might be defined as substances which, when injected into suitable animals, give rise to the production of antibodies; this would then include the toxins, enzymes, &c., substances which do not give the proteid reactions as usually accepted by chemists. At the time of writing, Ford's work on the production of antibody by what is apparently a carbohydrate derived from poisonous fungi had probably not appeared, but, nevertheless, with this possible exception it does appear to be true that all anti-bodies are the result of the action of proteid or proteid-like substances. In the chapter on phagocytosis, opsonins, opsonic determinations, and vaccine treatment are naturally considered at some length. The divergent views on the nature of opsonin are well summarised; the author considers that there appears to be no sufficient evidence for the existence of thermostable opsonin apart from amboceptor, and that if thermolabile opsonin is not complement, complements may play the part of opsonins. The vaccine treatment of infective diseases is dealt with somewhat fully, and the opinion is expressed that "of the practical success of this treatment in certain diseases there can be no doubt," particularly in diseases due to acute infections with staphylococci, pneumococci, *B. coli,* and some other organisms, but as regards tuberculosis only a moderate degree of success has been obtained by the author.

Dr. Emery evidently holds the opinion that determinations of the opsonic index are not essential for the control of dosage in vaccine treatment. He points out that a patient with a low opsonic index may improve under treatment, fresh lesions may appear when the index is high, and the index may rise greatly just before death, and says:—

"The more carefully the opsonic index is considered, the more certain will it appear that a high index is not an indication of immunity; it neither proves that the lesion is undergoing cure, nor that a fresh infection will not occur. . . . Nor is a low index any proof of lack of immunity, since patients may improve remarkably during a prolonged negative phase" (p. 280).

A chapter is devoted to the colloidal theory of antibodies and its bearing on such phenomena as agglutination and the interactions between toxin and antitoxin, and gives a good account of this difficult subject.

A final chapter deals briefly with the practical applications of immunity research in the treatment of infective diseases.

The book contains a glossary of terms, a useful bibliography, and is well and sufficiently illustrated. A number of small verbal errors somewhat mar the text, but a sheet of "errata" correcting most of them has recently been issued. We can recommend the book as an excellent summary of the voluminous literature on a difficult subject. R. T. HEWLETT.

THE CARBONISATION OF COAL.

Modern Coking Practice, including the Analysis of Materials and Products. By T. H. Byrom and J. E. Christopher. Pp. xi+156. (London: Crosby Lockwood and Son, 1910.) Price 8*s*. 6*d*. net.

IN the preface to this handbook the authors point out that

"The subject of coke manufacture is of rapidly increasing interest and significance, embracing as it does the recovery of valuable bye-products in which scientific control is of the first importance."

This declaration, taken in conjunction with the fact that one of the authors is a Fellow of the Institute of Chemistry, awakens the hope in the reader's mind that at length the technical library has been enriched by a work which might rank with Simmersbach's "Grundlagen der Koks-Chemie," and afford substantial aid to those studying the economic principles of coal distillation, which is one of the most important questions of the present century.

This expectation, however, is doomed to disappointment, as the reader soon finds that the title of the book should have been "Modern Coke-oven Construction and Practice," that all discussion as to the effect of temperature and mass on the distillation of coal and the products yielded is avoided, and that whilst the change in structure from the beehive coke-oven to the modern recovery plant is well dealt with, and the manufacture of sulphate of ammonia receives full attention, yet the subject of tar is dismissed in one page.

In speaking of tar fuel, on p. 5, the authors say:—

"The modern tendency, however, is to distil the tar first, and recover its many valuable constituents such as benzene, naphtha, carbolic acid, naphthalene, creosote, and also the tar colours discovered by Perkin."

This looseness of expression might lead some to believe that the coal-tar colours were a distillate from tar.

A few pages further on solid fuels are subdivided into organic and inorganic, the latter consisting of sulphur, silicon, phosphorus, and aluminium, the latter being credited with giving a heat quite equal to that produced in electric furnaces, a statement which will be doubted by the users of "Thermit."

In the chapters devoted to the construction of the modern form of bye-product recovery coke-oven, the authors are at their best, and this portion is well illustrated with many reproductions of photographs from existing plants, as well as elaborate sections and plans, yet the same fault is to be found as in other parts of the book, that is, the principles which govern the various stages in the process of carbonisation, and the chemical changes taking place during the operations, are ignored, whilst details of mechanical interest only are elaborated.

In the preface the reader is told that the book embodies a series of lectures delivered at a technical college to a class of men engaged on coke-ovens, and, interesting as they must have been to the audience, it cannot be too strongly impressed upon those delivering lectures of this kind that, unless there is given a foundation of scientific facts and theory upon which the practical man can build and evolve original ideas, the value of such lectures must be enormously lessened.

Not only is the theory of carbonisation neglected, but the coke produced during the process of gas manufacture is hardly mentioned, although the gas coke produced in the United Kingdom more than doubles in quantity that made in bye-product recovery plants, the beehive coke-oven, with its wicked waste of tar and sulphate of ammonia, still being the most favoured means of squandering our already depleted coal-measures.

At the present time there is a great opening for an author who, with scientific knowledge of the subject, can gather together the work of Stein, Flack, Richters, Muck, Parry, Thörner, Lunge, Knublauch, and others on the carbonisation of coal, and weave into tangible shape the lines upon which economy of coal, abolition of smoke, increase of manurial ammonium compounds, and enhanced values for our tar products can be obtained.

THE HUMAN CENTRAL NERVOUS SYSTEM.

Voordrachten over den Bouw van het centrale Zenuwstelsel—een Voorbereiding tot de Kliniek der Zenuwziekten. Door Prof. J. W. Langelaan. Pp. vi+485, and 309 text-figures. (Amsterdam: A. Versluys, 1910.)

THIS consists of the course of instruction on the embryology and anatomy of the human nervous system given in Leyden in the sessions 1907–8 and 1908–9 put into the form of a book, which is illustrated with an excellent series of photographs of sections and drawings by Heer G. Koster. It is quite a revelation to find what soft effects of light and shade the artist has obtained with pen and ink, without sacrificing accuracy and clearness, in the production of these admirable illustrations.

The book is subdivided into four sections, dealing respectively with (A) the development of the human central nervous system (pp. 1–98); (B) the nature and histogenesis of the nervous tissues (pp. 99–137); (C) the form of the various parts of the central nervous system (pp. 138–286); and (D) the structure of the central nervous system (pp. 287–485).

The most distinctive section of the book is part A. Part B contains a good and impartial summary of the present state of our knowledge concerning the mode of development and the nature of nerve-fibres and cells, and supplies the reader with a good bibliography. Although parts C and D, on the whole, are excellent accounts of the subjects of which they treat, they present no special features which the student cannot find elsewhere in text-books written in languages more generally understood than Dutch is. Moreover, the text of these sections is not so "up-to-date," nor is the bibliography so satisfactory as those of the early sections.

Section A is a model of the manner in which embryology should be taught to medical students.

It begins with a clear account of the early stages of development of the primate embryo, leading up to the formation of the nervous system, and then describes the history of the further growth and differentiation of the brain and spinal cord in *human* embryos. Most books on embryology are rendered confusing to the student by the introduction of descriptions of what happens in the chick or the developing rabbit, with tags of miscellaneous information concerning the embryos of other vertebrates, and the plea is urged in support of such a mode of procedure that it is the comparative method. But the use of data culled from comparative anatomy in works on human anatomy can be justified only when they help to elucidate the latter or explain some general principle which cannot be appreciated from the mere study of one vertebrate; unless the information directly serves one of these two purposes it is worse than useless to insert it. One of the great merits of Prof. Langelaan's work is that it gives a straightforward account of the human brain and its development; and no comparative data are inserted in the embryological section except to explain stages in human development which are not known from direct observation of human material; and then he is careful to rely almost exclusively on information obtained from the study of the mammals most nearly related to man that supply the desired facts.

A considerable part of the embryological section of the work is based upon the author's own researches, which are already familiar to readers of *Brain* (1908) and the *Anatomischer Anzeiger* (1908); and this fact gives section A the freshness which springs from first-hand knowledge, in contradistinction to the staleness of conventional errors which

mar all mere compilations, however conscientiously they may have been done.

Although there are a good many errors, both of commission and omission, in this book, and many statements which we cannot endorse, the work is, on the whole, the best elementary text-book on the anatomy of the human nervous system, and it certainly contains the most useful account of the development of the human brain that has appeared in a student's text-book. If it were not for the difficulty of language the book would appeal to a large class of students and medical men. G. E. S.

OUR BOOK SHELF.

The Miners' Guide. By F. P. Mennell. Pp. viii+196. (London: Gerrards, Ltd., 1909.) Price 4*s.* net.

THIS little book aims at being a guide to the prospector, and should largely attain its object. It is neither lengthy nor profound, but sketches, lightly, those principles of geology it is desirable that the prospector should be acquainted with.

In discussing the source of metals in lodes the author appears to lean strongly to the theory of lateral secretion, and is at some pains to show how large a quantity of metal may be contained in the rocks of a mineral district, even when barely perceptible traces of its existence can be detected by analysis. He is a firm believer in the underground circulation of meteoric waters as a means of dissolving and concentrating these metals in lodes and other deposits, and seems to doubt the existence of a bary-sphere.

The description, in chapter iii., of the characters of ore bodies is all too short, and chapter iv., which is devoted to prospecting, might also be expanded with advantage; but this is supplemented later by a review of the occurrence of, and prospecting for, gold, silver, platinum, the base metals, and other useful minerals and precious stones. An important feature of this portion of the book is a general account of the uses of the different minerals, and the conditions necessary to be observed in preparing them for the market. Prices and production also receive some attention, and the more important localities are cited. Chapter xi. deals with sampling, and in the space available gives a good description of the operations that must be undertaken, and the methods of computation that must be adopted, to ascertain the average value of a lode sampled. The following statement, however, "As a guide to the possibilities of undeveloped ground, geological knowledge is often worth any amount of sampling, but the miner can only judge from his own experience what scientific knowledge enables the geologist to gauge by the help of theories founded on other people's experience as well as his own," seems to assume a dangerous position and to tend to a reliance on theory, rather than actual testing, to determine the value of any mineral deposit.

The working notes are necessarily fragmentary, dealing as they do with alluvial working, including dredging; lode mining; methods of crushing, cyaniding, &c., in one short chapter. The book, however, contains many useful hints, and is one that should certainly appeal to the prospector in far lands.

The Coccidae of Ceylon. By E. Ernest Green. Part iv., with 39 plates. Pp. 251+344; plates xciv.–cxxxii. (London: Dulau and Co., 1909.)

THE work before us well illustrates the enormous recent development of our knowledge of entomology, for when Mr. Kirby published his "Catalogue of the Described Hemiptera Heteroptera and Homoptera of Ceylon," in the Journal of the Linnean Society (Zoology, vol. xxiv., 1891), he was only able to enumerate seven species of Coccidæ from the island—*Lecanium mangiferae,* Green (1889); *L. coffeae,* Walk. (1852); *L. viride,* Green (1889); *L. nigrum,* Nietn. (1861); *Pseudococcus adonidum,* Linn. (1758); *Coccus(?) floriger,* Walk. (1858), and *C. laniger,* Kirb. (1891).

Shortly afterwards, however, Mr. Green took up the systematic study of the Coccidæ in earnest, with such good results that he soon accumulated materials for a monograph of the Coccidæ of Ceylon. At first he estimated that it would probably run to four parts, containing thirty plates each; but now he finds that "the present (fourth) part contains many additional plates, which (with the several supplementary plates) bring the total number up to 135, or fifteen more than the number promised to my subscribers. For the completion of the monograph it will be necessary to bring out a fifth part, of double size, containing from fifty to sixty plates." Even so, considering the rapidity with which material accumulates, we should not be surprised if a further extension, or a speedy supplementary part, may not be found necessary.

But, however this may be, part iv. contains the conclusion of the subfamily Lecaniinæ, with nine genera and nineteen species; and the new subfamily Asterolecaniinæ, with six genera, 24 species, and two varieties.

The work is based almost entirely on Mr. Green's personal observations, and a large proportion of the species described and figured are new. We have nothing but praise for the text and letterpress of this monograph of a family of insects which is important both as destructive to vegetation and, in some instances (as in the cochineal insect), as yielding products of considerable commercial value.

Colonsay, one of the Hebrides. Its Plants: their Local Names and Uses. Legends, Ruins, and Place-names. Gaelic Names of Birds, Fishes, &c. Climate, Geological Formation, &c. By Murdoch McNeill. Pp. viii+216. (Edinburgh: David Douglas, 1910.) Price 2*s.* 6*d.* net.

THE main purpose of the author is to publish a list of plants collected during some years' stay on the island, to which he has added general notes on the history, geology, and fauna. The author has been a keen observer of the birds, both migratory and native; among the former are the barnacle goose, pintail duck, and wild swan, while eider-duck and cormorants live on the outlying reefs or unfrequented coast, and guillemots, buzzards, and kestrel nest on the northern shores. In the same localities with the eider-duck are found shoals of seal, both the large grey and common species.

A chapter is devoted to the description of the woods, lochs, and pastures. The lochs are the most interesting botanically. The white water-lily, the common reed, and bottle sedge are the most conspicuous plants in the shallows; species of Potamogeton and *Callitriche autumnalis* are abundant in the deeper waters. The enumeration of flowering plants and ferns amounts to 567 species, but this number includes garden escapes. The author has been fortunate in obtaining the cooperation of special authorities on certain genera. Mr. A. Bennet has identified a dozen species of Potamogeton, and a similar number of Rubi are given on the authority of Rev. W. M. Rogers. Among the more typical and rare plants are *Spergularia rupestris, Lobelia Dortmanni, Sedum roseum, Myosotis repens* and *Ligusticum scoticum.*

The book is pleasantly written, and contains a considerable amount of observational matter scattered through its pages. The Gaelic names and quotations will only be appreciated by a limited number of readers.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Stability and Efficiency of Kites.

In NATURE of March 17 Mr. Dines suggests that the instability of kites may be due to changes in the relation of the weight to the velocity of the wind, or to deformation of the kite by excessive pressure, or that there is a critical velocity at which the forms of the stream-lines become so altered that instability results.

My own experience leads to the opinion that deformation by a strong wind is practically the only important cause of instability. At the Blue Hill Observatory, where the conditions for experimenting are unusually severe, the Clayton modification of the Hargrave kite is the only one that can be employed. In this form the longitudinal sticks are continuous from one cell to the other, and the lateral sticks form the front and rear edges of the cells which prevent the fluttering of the cloth unavoidable in kites the rigidity of which depends upon the tension of the covering. The Clayton-Hargrave kite is rigid, but there is no strain or tension anywhere except when flying, and it has proved itself to be sufficiently stable. Relief from sudden and excessive strain is necessary, and to secure this the bridle is made elastic, so that in strong winds the angle of inclination becomes smaller. Thus equipped, the kite is not uniformly efficient in strong winds, for, as the angle of inclination becomes smaller, the pressure of the wind upon the edges of the cells becomes relatively greater, and the altitude is reduced. A normal altitude of 55° to 60° may be lowered to 40° by an increase of wind of 15 to 25 metres per second. If the front cell of the kite is equipped with rigid curved lifting surfaces the efficiency is greatly increased, the mean altitude exceeding 60°, and the loss due to increase of wind is unimportant in velocities up to 25 metres per second.

Some of the lightest of these kites have flown in the strongest winds encountered while experimenting, the velocity in some instances having exceeded 30 metres per second. An interesting example of this kind occurred on April 14 during the international ascension. Two kites, weighing 600 and 850 grams per square metre, and having lifting surfaces of 11 and 7 square metres, respectively, were employed to lift the line. The outer section of the line was 1500 metres of wire having a tensile strength of 140 kilograms, and the next was 2500 metres long, having a tensile strength of 180 kilograms. The large light kite was placed at the outer end of the line, and the other at the junction of the two sections. At a height of 2000 metres, with 3500 metres of line out, two gusts of wind resembling thunder-squalls were encountered, the mean velocity for twenty minutes exceeding 30 metres per second, and the maximum reaching 33. The strain on the line at the ground did not exceed 90 kilograms, and, allowing for the weight of the line, probably did not exceed 110 at the second kite. The pull of the larger kite in a 10-metre wind is usually about 45 kilograms, and that of the smaller about 35, and, allowing for the pressure of the wind on the line, this, apparently, was not greatly exceeded. The large kite will fly in a wind of 5 metres per second, and was perfectly steady in a velocity of 33 metres per second. The pressures corresponding to these velocities are, respectively, 2 and 80 kilograms per square metre of surface exposed normally; hence it seems improbable that a well-made kite could become unstable through disproportionate weight or some unusual property of a high wind. It should be said that the velocities given are "true" velocities, and not to be compared with those from the large Robinson anemometers, in which the factor 3 is employed. The maximum velocity referred to, expressed in English units, becomes 74 miles per hour "true" velocity, 90 when reduced to the U.S. Weather Bureau standard, or about 100 miles per hour when reduced to the same scale as the Kew pattern when the factor 3 is employed.

In 1900, while comparing different wires for use as kite-lines, I found that, theoretically, the larger wires were the more efficient, although slightly weaker, weight for weight, than the smaller. The reason for this is that the pressure of the wind is more effective upon the small wires than on the large. A No. 10 wire weighing 2·16 kilograms per 1000 metres usually breaks at 85 kilograms. Its diameter is 0·61 mm., and the surface presented to the wind is 1 square metre for each 1650 metres of length. If we wish to double the strength of our line we employ a wire 0·93 mm. in diameter, weighing 5 kilograms per 1000 metres of length. The cross-section, however, has increased only one-half, the surface presented to the wind being 1 square metre for each 1100 metres of length.

An opportunity to secure experimental data did not present itself until January, 1908. Since then, in conducting the monthly kite ascensions at Blue Hill, I have employed small kites flown with small wires, and large kites flown with large wires, to determine the relative efficiency of the two systems. The results show very conclusively that the system of large kites and large wires is the more efficient, not only for the sizes experimented with, but very probably for much larger sizes. The lifting surface of the kites employed has varied from 3 to 13 square metres, and the line has been made up of pieces of wire varying from No. 10, of 85 kilograms, to No. 21, of 235 kilograms, tensile strength.

The opinion, held by many, that large kites are inferior to small kites in meteorological work is not sustained by these experiments. The Clayton-Hargrave kite when built with three sections can be made stronger for the same weight than when made with two or four sections. The increase of weight as the size increases is unimportant in meteorological experiments, for kites with lifting surfaces exceeding 15 square metres need not weigh more than 650 grams per square metre. The ability of these larger kites to withstand high winds apparently is greater than that of small kites, for the large and heavy sticks necessary in the framework, like the large wires, present relatively a smaller cross-section to the wind for a proportionate weight and strength.

Increased stability may be secured by placing two diverging vertical planes in the rear cell of a kite. If these planes are adjustable, the kite may be caused to fly on either side of the mean direction of the wind, or any errors of flight may be corrected.

The entire question of stability appears to be one of eliminating unequal strains and unnecessary resistances.

F. P. FERGUSSON.

Hyde Park, Mass., U.S.A., April 20.

I AM much interested in Mr. Fergusson's letter, and his long experience with kites, about double my own, makes me very diffident about expressing an opinion contrary to his.

Doubtless deformation is a very fruitful source of instability, but after carrying out some thousand kite ascents from a steamer and on land, I am of opinion that it is not the only cause. However, my position is that we do not know with certainty the cause of instability, and it is very desirable at the present time that we should know beyond dispute.

I agree with Mr. Fergusson as to the advantages of large kites; they are more stable than small ones, and, as he has shown, since the wind resistance on the wire is the one serious obstacle to reaching great heights, it is obviously desirable to make that resistance small in proportion to the other forces. But there are practical objections. Large kites and thick wire require a stronger and more expensive outfit, and more assistance at starting and landing; also, should an accident occur, the risk of its being serious is far greater.

I do not agree with Mr. Fergusson that the Clayton-Hargrave kite is the only one that can be used when the wind is strong. The conditions in England in the winter are probably more severe than at Blue Hill, and have been particularly severe during the last winter. Nevertheless, the strength of the wind has on no occasion prevented our

flying a kite with non-rigid edges at Pyrton Hill, and we have been fortunate in breaking only one kite in landing it, and in not failing once since last October to bring back the kite to the starting point without accident; also Mr. Cody's kite, which has non-rigid edges, will certainly fly in a strong wind.

Mr. Fergusson states that a kite of 7 square metres surface will exert a pull of 35 kilograms in a wind of 10 metres per second. In English units this is equivalent to 1 lb. per sq. foot of sail area in a wind of 22½ miles per hour. If the whole area were exposed normally to the wind, the pressure or pull would be 53 kilograms, and hence, remembering that the back sails are partially sheltered by the front, and that the angle of incidence is only about 15 degrees, 35 km. seems a very high value. The pull of a diamond-shaped box kite of 7 metres sail area in the same wind is certainly below 15 km. It would be interesting if Mr. Fergusson would tell us how the wind at the kite is measured at Blue Hill. I do not think any anemometer placed in the kite can be trustworthy—one might as well place one close to the roof of a house amongst a set of chimney stacks—and if an anemometer is placed on the wire there is the difficulty of avoiding oscillation and of correct orientation.

I am glad to be able to state that we do not now officially publish in England values of wind velocity based on the factor 3 for the Kew pattern Robinson cups, but on the factor 2·2. This reduces what would have been called 100 to 73; but the values quoted by me in my letter of March 17 are entirely independent of the Robinson anemometer. For reasons fully given in a recent publication of the Meteorological Office (M.O. 202) those values are doubtful, but the evidence is in favour of their being too low rather than too high.

I should like to take this opportunity of replying to Mr. Gold's criticism of the method of measuring wind velocities on a kite in England, namely, by measuring the tension of a piece of cotton carrying a light sphere at the far end, away from, and out of the influence of, the kite (Nature, April 21). It is true that the surface of the cotton exposed to the wind is comparable with that of the sphere, but the force is for all practical purposes a normal one, since the tangential component is admitted by all to be very small. It follows that the tension of the cotton, neglecting its weight, is the same throughout, just as in the case of the string stretched on a smooth curve given in text-books on mechanics, and hence the tension measured is the tension of the cotton where it is tied to the sphere, and is independent of the length.

W. H. Dines.

A Difference in the Photoelectric Effect caused by Incident and Divergent Light.

Recent investigations have shown that the ionisation produced by the secondary rays arising from a thin metal plate traversed normally by a primary beam of Röntgen or γ rays is greater on the emergent than on the incident side. The present experiments were made to see if a similar effect could be detected with ultra-violet light.

Thin films of platinum were prepared by sputtering from a platinum kathode on to quartz plates 1 mm. thick. These could be mounted in the centre of two similar brass cylinders so that their planes were perpendicular to the axes of the cylinders. A narrow beam of ultra-violet light from an arc passed down the axis of the two cylinders normally to the plates. The saturation current from the illuminated plates to the cylinders could be measured. The plates could also be turned so that the film side was either away from (position A) or towards the light (position B).

In every experiment two similar plates were used; one was used as a standard to determine the strength of the ultra-violet light, and its position, whether A or B, was unchanged. The other plate was compared with this for each of the two positions alternately. By referring each measurement to the standard plate, the otherwise troublesome variations of the arc were rendered harmless. Unless the films were very thick it was always found that position A gave rise to a relatively greater photoelectric current than position B, although it was penalised by having to pass through the thickness of the quartz plate.

When no allowance is made for the absorption by the quartz, a very thin film gives 12 per cent. more photoelectric current for the emergent than for the incident light. When the absorption of the quartz is allowed for the difference is increased to 16 per cent.

These results have been confirmed by reversing the direction of the light without altering the position of the plates, and other experiments have been made to ensure that they do not arise from scattered light or other defects in the apparatus. The ratio of the emergent to the incident effect has been determined for a series of films of varying thickness.

This investigation was suggested to me by Prof. O. W. Richardson, and the experiments have been carried out under his direction.

Otto Stuhlmann, Jun.

Palmer Laboratory, Princeton, N.J., April 26.

A Link in the Evolution of the Bees.

The ligula or "tongue" of the bees presents two main types, one broad, obtuse, and often emarginate, the other pointed, acute, frequently much elongated. The obtuse-tongued bees have been considered to be the more primitive, and there is no doubt that the most advanced types are long-tongued. The difference between the two groups has seemed so important that at one time (Trans. American Entomological Soc., xxix., p. 185) I entertained the idea that they had no common bee-ancestry, but were derived from different groups of wasps.

Frederick Smith, in 1853, described a new genus of bees from Australia under the name Meroglossa. This was based on a male from Port Essington, which had many of the characters of the obtuse-tongued Prosopis, but had a pointed, dagger-like tongue. Ashmead, in 1899, placed it in the same group as Prosopis, in spite of the tongue; in 1905 (Trans. Amer. Ent. Soc., xxxi., p. 318) I gave an account of Smith's type, remarking that it was "not unlike some Prosopis." In 1905 I described a number of Australian species supposed to belong to Prosopis, but remarked of one of them (*P. turneriana*) that the mouth-parts did not seem to agree with the genus. I had at that time no material for dissection, but Dr. R. C. L. Perkins had such material, and discovered that several had acute tongues. In Proc. Hawaiian Entom. Soc., October, 1908, he founded the genus Palæorhiza for my *P. perviridis*, with the following interesting remarks:—

"Palæorhiza is evidently represented by many species in Australia. Several have been described as belonging to the genus Prosopis, in spite of the fact that the most superficial examination shows that these insects have an acute lanceolate tongue. Hitherto no connecting-link between the blunt-tongued and acute-tongued bees has been recorded, but in Palæorhiza we have a form which, except for the structure of the tongue, would be assigned to the section of Obtusilingues. It will therefore be obvious that this section and the Acutilingues can no longer be maintained as of great importance, since Palæorhiza must always be associated with Prosopis, as the male genital characters, and all other ones, save the lingual, clearly show."

Nevertheless, he proposes for Palæorhiza a distinct family, Palæorhizidæ, at the same time suggesting that it should be Meroglossidæ if Meroglossa is allied.

In the course of going over the splendid collection of Australian bees formed by Mr. Rowland E. Turner, now the property of the British Museum, I have been able to examine the structure of a number of species of Palæorhiza. In the first place, I find that Palæorhiza and Meroglossa are substantially the same genus; but the truly astonishing thing is that the females have broad, obtuse tongues like Prosopis, while the males have sharp, dagger-like tongues! I first discovered this in *P. penetrata*, subsp. *percrassa* (properly *Meroglossa penetrata percrassa*), a black insect with the face of the male canaliculate, much in the manner of the original type of Meroglossa. My natural thought was that there must be two species, in spite of every appearance to the contrary. I next took

the undoubted sexes of *Meroglossa parallela* (Ckll.), a metallic insect related to the type of Palæorhiza, and these showed exactly the same thing. I then looked at a new species (*Palaeorhiza* or *Meroglossa melanura*), with a honey-coloured abdomen black at apex, the mesothorax striped with yellow and black, and the base of the metathorax finely longitudinally fluted. In this the sexes were associated without a doubt, and the difference in the tongues was as in the others. Still others were examined, all with the same result. It appears that the female in this genus lacks, or fails to develop, the determiner which represents the pointed apex of the tongue. Another peculiar character, a comb on the first two joints of the maxillary palpi, is common to both sexes of Meroglossa.

Another generic name for Australian bees must fall. The study of additional material shows that my Prosopisteron is not valid; its type-species must be known as *Prosopis serotinella*.

The extraordinary *Pachyprosopis mirabilis* of Perkins, described from N. Queensland, without further data, was taken by Mr. Turner at Mackay in May, 1900.

T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado, U.S.A., April 21.

Fluorescent Absorption.

IN NATURE of January 6 Mr. Burke criticises the conclusions which I drew from my experiments proving that fluorescent absorption does not exist (*Phil. Mag.*, 1909).

The method which I devised was a direct one, and free from all sources of error. I cannot see any point in Mr. Burke's criticism; I used a scheme for making the source of light and the fluorescing absorbing cell intermittent, throwing the flashes either "out-of-step" or "in-step" at will. If the flashes were out-of-step, the light from the source traversed the absorbing cell while it was not fluorescing. This flash entered the eye, and was immediately followed by the flash of fluorescent light from the cell, the source being in darkness during its emission. The total amount of light, or the sum of the two sets of flashes, was the same whether they were "in-step" or "out-of-step," showing that the absorbing power of the cell was not increased by its fluorescence. Mr. Burke now appears to stand alone as a champion of fluorescent absorption, for Nichols and Merritt have recently repeated their work with improved apparatus and methods (one of them being a modification of my stroboscopic method), and have failed to find any trace of the phenomenon.

R. W. WOOD.

Johns Hopkins University, April 28.

Centre of Gravity of Annual Rainfall.

MR. WATT's *nil admirari* attitude towards the C.G. of annual rainfall is unfortunate, for, notwithstanding his disclaimer in the first sentence, I find that his statement in the last sentence of his letter in NATURE of April 28 is another *a priori* shot! In the Mysore rainfall annual reports of the last fifteen years I have given diagrams of the monthly rainfall of the eight districts as percentages of the yearly totals, but they are not *simple*, or *similar*, or *symmetrical*. Yet year after year there is a close agreement in the C.G., or date round which each year's rainfall balances. *Verb. sat, sap.*

J. COOK.

30 Hermitage Gardens, Edinburgh, May 3.

Impure Manganese Di-oxide.

A FEW weeks ago I had occasion to order a quantity of manganese di-oxide for general lecture and laboratory experiments, and we duly received the same from a well-known firm the name of which it would be invidious to mention. Although in colour the manganese di-oxide was normal, we soon found that its chemical properties were very erratic. When mixed with potassium chlorate and heated gently, the mass inflamed inside the flask, and a reaction proceeded with explosive violence, resulting in the formation of clouds of smoky gas relatively poor in oxygen. When warmed with concentrated hydrochloric acid the action was unusually vigorous, and an inferior grade of chlorine was evolved possessed of a curious odour resembling that of euchlorine. The black colour of the powder rapidly disappeared, yielding a yellow solution, and a white, insoluble residue, which, from its voluminous appearance, suggested silica.

One of my senior students, Mr. William Davison, thereupon analysed the di-oxide, and obtained the following results:—

	Per cent.
Manganese di-oxide	60·06
Antimonious oxide	33·64
Silica	2·20
Ferric oxide	3·00
Arsenious oxide	trace
Sulphur	trace
Moisture	1·05
	99·95

That this was a case of wilful adulteration I do not suppose for a moment; but it seems desirable to direct the attention of teachers and others to the possibility of such a common and cheap article as manganese di-oxide being sold, not only in an impure form, but in one which it is positively dangerous to use with potassium chlorate for such a simple and universal experiment as the preparation of oxygen.

J. NEWTON FRIEND.

The Technical College, Darlington, May 6.

BRITISH NEW GUINEA.

COLONEL MACKAY was chairman of a Royal Commission appointed to proceed from Australia to inquire into the present conditions of the territory now known as British New Guinea. As such, he proceeded along the south coast of the island to its eastern extremity, then visited the D'Entrecasteaux and other groups in the offing, subsequently proceeding along the north coast to Buna Bay. Here he left the sea and struck inland to visit the Yodda Goldfield, returning overland to Port Moresby. This was the most arduous and interesting part of his journey, for the Owen Stanley Mountains, which here reach about 7000 feet, had to be crossed. Apparently the range really consisted of a series of more or less parallel ridges, up and down which the party was scrambling for seventeen days, camping during much of the time in tropical rain forest.

It is the record of the above trip which "Across Papua"[1] presents to us in pleasantly written form. The expedition was not in any way a scientific one, but the author shows that he has considerable powers of observation. He notes "the absence of stone on the higher ridges, and the extreme narrowness of their root-strewn, moss-carpeted crests. How also, as we approached the higher altitudes, lichen and moss gradually enveloped the timber until they covered limbs and leaves alike; but what impressed me most was the serene calm that reigned over all, for I heard no crash of fierce or fearful animal, no sound of human voice, no song of radiant bird in all that kingdom of mist and sunshine, of sparkling dew-gems, and immemorial silence."

The truth of this traveller's description we know well, but what wealth it suggests to the tropical naturalist—the enormous variety of plants which make up such a forest, each with its peculiar insects, many lizards and frogs showing quite peculiar adaptations to their damp environment, peculiar land shells on every ridge. The natives live on the lower slopes, but seem to be less cannibal and of better stock than

[1] "Across Papua." Being an Account of a Voyage Round, and a March Across, the Territory of Papua with the Royal Commission. By Colonel Kenneth Mackay, C.B. Pp. xvi+192. (London: Witherby and Co.) Price 7s. 6d. net.

those of the coast. Here would be an unique chance. At present the country is untouched, but in a dozen years it may well be opened up, and if gold be found all would fall before the axe.

Colonel Mackay's observations suggest much work, too, for the ethnologist. The Yodda Goldfields have brought to light red pottery with designs, and stone bowls with patterns on their rims, indicating that the country was once occupied by a race superior to the present Papuans. The latter, too, even on the coast, are interesting enough, but they are fast getting spoilt by the missionaries and traders. Those of the hills near "the gardens of the ghosts" are still untouched, making mummies of their dead, for whom they have a supreme respect. The splay-footed people near Cape Nelson should also be well worth a visit.

It is rightly pointed out that no tropical country can remain long undeveloped, owing to the teeming millions of the overcrowded East, and British New Guinea, to be secure, must be opened up. Coco-nuts, coffee, cocoa, and rubber will probably in a generation cover most of the available land, while gold may

Native Trading Vessels of Port Moresby. From "Across Papua."

cause still more rapid growth. The book before us will doubtless assist this development, as the conditions and climate are shown to be by no means worse than those of Ceylon or the Straits not many years ago. Perhaps this is the aim of the book, but we confess that we desire the more solid observations of a trained naturalist. Unfortunately, such have not always the brightness and sense of humour possessed by Colonel Mackay. J. S. G.

SOME RECENT AGRICULTURAL FIELD TRIALS.[1]

SINCE the application of the "whisky" money to agricultural education in Great Britain a considerable amount of experimental work has been carried on by some of the more energetic of the county committees. A few of the experiments deal with animals but by far the greater number with crops, presumably because the expense is less; they serve a variety of useful purposes, arousing an interest in practical agriculture, showing the farmer (if, indeed, he needs showing) that artificial manures will give increases in crop, and, finally, they may furnish very useful material for the county agricultural lecturers.

Field experiments are perhaps the most difficult of all experiments to interpret. The growth of plants is influenced by so many factors—temperature, water supply, food supply, &c.—that small variations in the conditions may lead to marked differences in result. The soil is a very complex mixture and not uncommonly shows some variation even within the limits of a single field. Even if the soil itself is tolerably uniform a slope may introduce irregularities. The influence of a tree or hedge makes itself felt for some distance, while the effect of the previous treatment of the ground is often very great. Of course, if the intention is mainly to get up an interest in agricultural trials these considerations are of little moment, but they assume great importance where it is desired to give definite information about the effect of manures on the crops. A perusal of the reports before us leaves a rather mixed impression. There has been a vast amount of work done, and much industry and energy have been displayed, but it is not always clear that the experimenters have grasped the first principles of the art of making experiments. In no case is the experimental error indicated, nor can we find it has been ascertained; indeed, so far as we know, it is only at Rothamsted that the determination is made, and there, where all the conditions are favourable and the workers thoroughly competent, it amounts to 10 per cent.

In the Sussex experiments a number of plots were laid out on each of twenty farms and received various combinations of artificial manures. As the experiments have only gone on for one year it is impossible to draw any definite conclusion, so great is the disturbing effect of season. In the discussion all the results have been averaged, in spite of the fact that the soil varied from a chalk loam in some centres to a heavy clay probably destitute of chalk in others. It is, of course, not legitimate to take an average of incomparable quantities, and we suggest that more useful results would be obtained by arranging the soils into strictly comparable groups.

The Northumberland experiments have gone on for a longer time and averages for several years are given, so that the effect of season is more or less eliminated. They are well known as illustrating the value of basic slag in improving poor clay pastures. On the light soils potash has been found very effective. A more detailed study could be made if the

[1] West of Scotland Agricultural College, Reports on Experiments; Durham County Council Education Committee, Report of Dairy Investigations; Northumberland Education Committee, Guide to Experiments for 1909; East Sussex Education Committee, Experiments on Meadow Hay; Agricultural Students' Gazette, Experiments on Pasture; Journal of the Department of Agriculture and Technical Instruction for Ireland.

error of the experiment was known. Thus we are informed that the most effective slags are those in which a high percentage of the phosphates present dissolves in citric acid. On looking at the figures, however, we find that the extreme difference in yield is little more than 10 per cent., which is probably well within the experimental error.

Percentage of phosphoric acid soluble in 2% citric acid	93·1	74·2	66·1
Hay obtained, in cwts.	9⅛	9⅛	8

Again, one of the conclusions drawn from the rotation experiments is that sulphate of ammonia has had distinctly exhausting results except on the crop to which it was applied. The fall in yield, however, is only 7 per cent. In neither case is the conclusion justified by the evidence.

Among the West of Scotland reports is one in which the new nitrogen manures, cyanamide and basic calcium nitrate, are shown to have given valuable returns. Most of the reports deal with different varieties of oats and potatoes. General conclusions cannot be drawn since we are told "that the character of the seasons was found to affect the relative as well as the absolute productiveness of the oat varieties in an astonishing degree." A number of measurements of the straw and grain of these different varieties are recorded, and a good deal of other information has been collected. In the experiments on the manuring of potatoes it generally happened that the best and most profitable crops were obtained after applying ten tons of farmyard manure per acre along with a complete dressing of superphosphate, sulphate of potash, and sulphate of ammonia, a result agreeing with others obtained elsewhere.

The Cirencester experiments on pasture have been going on for eighteen years or more, and show some interesting results worth working up in greater detail, since they differ in several ways from those obtained at Rothamsted. Thus superphosphates alone gave better results than no manure and also encouraged clover; the plot receiving sodium nitrate alone was poor, tufted, and worse than the plot receiving ammonium sulphate alone; Ustilago was most prevalent on the plot receiving kainit alone.

The Irish experiments on winter milk production and winter rearing of calves were made to see if either of these schemes would pay. At present Ireland places but little butter on the market during winter, with the result that the summer trade suffers. It is considered that higher prices would be realised in summer if the winter trade could be developed. Satisfactory financial results were obtained. The reports derive considerable interest from the tables of costs, a welcome though rather unusual feature in experiments of this sort.

The Durham dairy investigations were intended to settle certain practical points such as the feeding of concentrated food on pasture and the relative value of moderate and heavy rations for milch cows. It was shown that an increase in food caused an increase, but not a proportionate increase, in milk yield, a result in accordance with Holtsmark's very complete investigations in Norway. Brewers' grains were, as usual, found to increase milk production, but no attempts were made to ascertain whether, as is sometimes asserted, they have any physiological action. This is all the more unfortunate since in a second series of experiments the materials for this study seem to have been at hand, the increase in milk yield amounting in the two experiments only to 0·7 per cent. and 3·3 per cent. There is nothing to indicate the magnitude of the experimental error, but as only five cows were taken in each set it cannot have been less than the quantities recorded. The only legitimate conclusion is that brewers' grains in this particula instance failed to produce their usual effect. Here i just the experiment that the trained investigator woul have welcomed in order to follow up the subject But the author of the bulletin not only misses th opportunity, but draws the wholly unwarrantable con clusion that a moderate allowance of 20 lb. of brewers grains per day has the effect "of increasing, at al events for a certain period, the daily yield of milk"

We have directed attention to these defects becaus they recur not infrequently in the work carried on i the counties. Unfortunately some of our agricultura experimenters have a habit of ignoring or explainin away an unexpected result. If only they would lear that to follow up an unexpected result is the beginnin of wisdom in research work, we might make muc greater progress in agricultural science than we ar doing now. Of course, it may be urged that th object of the experiment is simply to arouse interes or to demonstrate some well-ascertained fact, so tha scientific method is not necessary. Even if the experi ments have served the purpose for which they wer intended it is nevertheless much to be desired tha the experimenters should realise their opportuniti and make more than they are doing out of their work

THE TOTAL SOLAR ECLIPSE, MAY 9, 191

UNFORTUNATELY, the news to hand regardin the observation of this eclipse, visible in Ta mania, tells us that all the observing parties exper enced unfavourable weather conditions. According t the *Times* of May 10, a Reuter telegram from Hoba (Tasmania), dated the previous day, states, "Th observation of the total eclipse of the sun fro Bruni Island has failed, owing to dense cloud and rain. Mr. Baracchi, the Victorian Governme astronomer, reports that the darkness during the peri of totality might be compared with that of a star night."

A cablegram from Mr. McClean, dated May 1 shows that this party also met with no success, o account of bad weather. The message was a follows:—"Eclipse invisible, steady rain all day. Onl two fine days last fortnight. Terrific gales and thu der frequent."

While it is most disappointing that no observatio of this eclipse have been secured, yet it was rath anticipated that such would be the case, owing the unfavourable time of the year for satisfacto weather conditions. Nevertheless, Mr. McClean d serves high praise for getting a party together, wi a fine outfit of instruments, and going so far to ma the attempt to secure observations. While he retur on the *Orvieto*, which leaves Melbourne on May he has made arrangements to leave all his instr ments out there so that he can pick them up for t total eclipse of next year. This eclipse will be b visible from some of the islands in the western Paci but it is not yet settled which particular one will for the basis of operations.

The last mail from Australia has brought some d tails as to the station which Mr. McClean is just le ing and the preparations he made, and it is hoped th these will be published in a subsequent number NATURE.

W. J. S. LOCKYER.

PROF. E. F. W. PFLÜGER.

THE name of Pflüger has been made known many generations of students as belonging some inhuman agency by which, to their confusi and vexation, an edict was enacted known "Pflüger's law." To how many of those students h the human picture ever been presented of the untiri

young *privat-docent*, working alone in his single room night after night for two years without an interruption until, in 1859, he published his accumulated results in a bulky volume, "Untersuchungen ueber der Physiologie des Elektrotonus," Berlin, 1859?

By the side of this picture of the active young searcher in the 'fifties of last century might be placed a picture of the no less active learner of the 'nineties who, at the age of seventy, with forty years of service behind him as professor of physiology in the University of Bonn, and with no worldly reward in front of him of money or position or of fame, day by day and month by month carried out with his own hand the mechanical *minutiae* of daily quantitative estimation of nitrogen necessary to satisfy his mind as to the balance sheet of nitrogen of a dog under physiological conditions strictly supervised by himself, and, as is shown by the 131 volumes of Pflüger's *Archiv*, of which the first volume appeared in 1868 and the 131st in 1910. His faithful service to physiology continued for ten years longer, to the fifty-first year of his ordinary professorship, to the eighty-first year of his life.

Eduard Friedrich Wilhelm Pflüger, born in 1829, a pupil of Johannes Muller, is the last of the great German school of physiological and biological workers —Hæckel, Lieberkühn, Du Bois Reymond, Henle, Ludwig, Brücke, Helmholtz, Pflüger.

Pflüger lived a retired life, devoted to his work in the laboratory and in the library, which he hardly ever left, and in which he did not welcome the interruption of the visitor; *no one admitted except on business* might well have been the inscription upon his door, and he was never seen at physiological congresses. I count among one of the pleasantest recollections of my life a day spent in Pflüger's laboratory with Pflüger himself and Heinrich Herz, whose simple demonstration of Maxwell's forecast had been made in the previous year, and whom death so soon cut short. We spent the day watching the movements of Lippmann's capillary electrometer, and the time passed unnoticed; there was no inhumanity in connection with the author of Pflüger's law when the accuracy of a physiological assertion of fact was to be scrutinised.

To the scientific world Pflüger's permanent monument consists in the 131 volumes of Pflüger's *Archiv*. Many workmen have contributed to that monument, and, among the mass of contributions, the work of Pflüger himself stands good as well and truly laid. The mechanism of spinal action in the frog, and his law of reflex action as studied upon the decapitated animal, were his earliest subjects of study, and are to-day still classical. We cannot discuss the mechanism of nervous coordination without at once appealing to the experiments of Pflüger and the decapitated frog more than fifty years ago, in preface to our discussion of the experiments of Sherrington on the spinal mammal which belongs to the last decade.

The tenth volume of Pflüger's *Archiv* (1875), containing his paper, "Ueber die Physiologische Verbrennung in den lebendigen Organismen," has played an important part in our knowledge and notions as to the chemical respiration of the tissues.

Pflüger's bloodless and salted frog continuing to discharge CO_2 in an atmosphere of nitrogen or in vacuo is clear evidence that CO_2 is not due to the immediate action of oxygen, but that it is formed from the dissociation of some storage compound, or, as Pflüger expressed it, previously absorbed oxygen has helped to wind up the physiological clock, the CO_2 discharged at the moment is a sign that the clock is running down. In discussing the latest contribution to our knowledge of this subject, those, for instance, brought out by Leonard Hill as regards the beneficial effect of oxygen upon muscular work, we are obliged to refer to Pflüger's teaching.

Nutrition, its debtor and creditor account in the body in terms of nitrogen and of carbon; glycogen, its relation to carbohydrate antecedent and its questionable relation to protein antecedents; fat, its absorption, relation to carbohydrate, the problem of diabetes and the origin of diabetic sugar, formed the principal field of Pflüger's unceasing labours during the last twenty-five years of his life.

Pflüger died on March 17, aged eighty-one, at the end of over sixty years of single-minded and unswerving devotion as a student of physiology, fifty years of which were spent as ordinary professor of physiology in the University of Bonn.

A. D. Waller.

NOTES.

In consequence of the lamented death of the King, and out of respect to his memory, many scientific meetings and other functions have been postponed or cancelled. The *soirée* of the Royal Society, announced for May 25, will not take place. The meetings of the society will not be resumed until May 26. The president of the Royal Institution has decided that the lectures and evening meetings be discontinued until further notice. The anniversary dinner of the Royal Geographical Society, which was arranged for May 23, will not be held; the anniversary meeting will be held as arranged, at 3 p.m. The meeting of the Royal Meteorological Society which had been fixed for Wednesday, May 18, has been postponed to Wednesday, May 25.

We notice with regret the announcement of the death of Prof. S. Cannizzaro, Foreign Member of the Royal Society and professor of chemistry in the University of Rome, at eighty-three years of age.

At the meeting of the Royal Society on May 5 the following candidates for fellowship were elected into the society:—Mr. J. Barcroft, Prof. G. C. Bourne, Prof. A. P. Coleman, Dr. F. A. Dixey, Dr. L. N. G. Filon, Mr. A. Fowler, Dr. A. E. Garrod, Mr. G. H. Hardy, Dr. J. A. Harker, Prof. J. T. Hewitt, Prof. B. Hopkinson, Dr. A. Lapworth, Lieut.-Colonel Sir W. B. Leishman, Mr. H. G. Plimmer, and Mr. F. Soddy.

Now that our returning summer migrants are being eagerly looked out for, and the arrival of many of them has been recorded during the last few weeks, the question arises in the minds of many people, "Do the same individual birds which nested last year come back to nest in the same place?" This is a question, of course, which might be equally well asked of our "resident" birds, but in the case of migrants, such as the swallow, which we know for certain does not winter anywhere north of Africa, actual proof that the same individual returns after its long journey to and fro, and its sojourn in its far off winter quarters, to the very same spot in which it nested the year before is sensational. Such proof in the case of one swallow, in any case, is just to hand. Dr. C. B. Ticehurst records the following in the last number of *British Birds*:—"On April 12, 1910, the first swallow (*Hirundo rustica*) was seen at 4 p.m. passing the house at Huntbourne, High Halden, Kent, which lies in the line of a small migration-route; at 6 p.m. a small flight of swallows passed over to the north, and from it four birds separated, and after flying round the house and settling on the chimney-pots, finally went to roost in a shed where two pairs bred last year. Two days afterwards I caught a

swallow at roost in this shed, almost certainly one of those that arrived on April 12, and found it was one which my sister had caught and ringed as an adult bird on May 8, 1909, the bird having come down one of the chimneys into one of the rooms. I may note that there was no mark or injury of any kind on the leg which bore the ring." The system of marking birds by aluminium rings will no doubt teach us much that we cannot learn by any other means. Last year more than 2000 birds were "ringed" by readers of Mr. H. F. Witherby's magazine *British Birds*, and this year at least double that number will be "ringed." Each ring bears a separate number as well as the inscription "Witherby, High Holborn, London," and careful details are kept of the date and place at which each bird was marked. Should any of these ringed birds fall into the hands of any readers of Nature, Mr. Witherby would be glad to be informed of the date and place of the capture and the number on the ring.

Prof. Walter Nernst, director of the Physical Chemistry Institute in the University of Berlin, has been elected an honorary member of the Manchester Literary and Philosophical Society.

An International Conference will meet in Paris on May 18 to consider the questions raised by the development of aërial navigation, with the object of arriving at an international agreement with respect to them. Most of the European Powers will be represented. Delegates to represent the United Kingdom have been nominated by the Admiralty, the Army Council, the Board of Trade, and the Secretary of State for the Home Department.

The prize of 20*l.* recently offered by the Scottish Meteorological Society for the best essay on a meteorological subject has been awarded by the council of the society to Mr. David MacOwan, of Edinburgh University, for an essay on "Atmospheric Electricity." The competition, it may be recalled, was open to students of the Scottish universities and to graduates of not more than five years' standing.

Dr. and Mrs. Seligmann have returned from their first exploratory ethnological survey of the Anglo-Egyptian Sudan, to which they were appointed by the Anglo-Egyptian Government. They studied the hitherto uninvestigated Nubas of southern Kordofan, and the Shilluks, Dinkas, and Shir of the White Nile. A short time was spent between the White and Blue Niles, where a Neolithic site was discovered. Observations were made on the sociology and religion of various tribes, and some anthropometrical data were obtained, especially of the Nubas.

At the meeting of the American Philosophical Society on April 23, the following foreign members were elected:—Prof. A. von Meyer, Madame Curie, Sir David Gill, K.C.B., Prof. E. Meyer, and Prof. C. E. Picard. We learn from *Science* that members of the U.S. National Academy of Sciences have been elected as follows:—Prof. F. R. Moulton, Prof. W. A. Noyes, Mr. T. B. Osborne, Prof. C. Schuchert, Prof. D. H. Campbell, Prof. J. Loeb, and Prof. J. Dewey. Dr. G. E. Hale has been elected foreign secretary of the academy, to succeed the late Prof. Alexander Agassiz. The Draper medal has been conferred on Dr. C. G. Abbot, director of the Astrophysical Observatory of the Smithsonian Institution.

The Royal College of Physicians announces that the next award of the Weber-Parkes prize of 150 guineas and a silver medal will be made in 1912, and that the adjudicators have selected as the subject of the essay "The Influence of Mixed and Secondary Infections upon Pulmonary Tuberculosis in Man, and the Measures, Preventive and Curative, for dealing with Them." The Croonian lectures of the college will be delivered in June next by Dr. F. W. Andrewes, the Harveian oration in October by Dr. H. B. Donkin, the Bradshaw lecture by Dr. G. N. Pitt, the FitzPatrick lectures by Sir T. Clifford Allbutt, and the Horace Dobell lecture by Dr. W. Bulloch.

The annual autumn meeting of the Institute of Metals will be held in Glasgow on September 21–22, on which days papers of scientific and practical interest will be read and visits made to works of metallurgical interest. An influential local committee, of which Prof. A. Barr is chairman and Dr. Cecil H. Desch is honorary secretary, has already been formed to carry out the necessary arrangements, of which further notice will be given in due course. There has been established at the offices of the institute a pathological museum for specimens of metals and alloys, the first contributions to the museum having been received from the president, Sir Gerard A. Muntz, Bart. This museum, which is the only one of its kind, ought to be of great service to all interested in the metallurgy of the non-ferrous metals, as it is intended that it shall contain specimens showing the various ways in which such metals as copper, brass, aluminium, &c., can fail either as a result of faulty manufacture or of improper usage.

A Reuter message of May 5 from San Juan del Sur, Nicaragua, stated that Cartago, Costa Rica, was practically destroyed by an earthquake at 6.30 p.m. on May 4. Five Central American Republics reported earthquake shocks. The *Times* Washington correspondent says that though Costa Rica is supposed to be the southern limit of the earthquake zone, the discussion has again commenced as to whether a sea-level canal would not have been more stable than the lock type for the Panama Canal now under construction. According to Reuter, two hours after the shock a brilliant meteor passed over the Costa Rica-Nicaraguan frontier, leaving a luminous track behind it, and augmenting the fears of the populace. As in many other cases, this earthquake occurred as the moon was approaching perigee on May 8 and conjunction on May 9, so that the conditions were favourable to deformation of the earth's crust.

An International Congress in Naval Architecture and Marine Engineering will be held in London on July 4–8. From a preliminary programme issued by the Institution of Naval Architects we learn that there will be a reception on the evening of July 4, and that the congress will be opened formally on Tuesday, July 5. The mornings of July 6–8 will be devoted to the reading and discussion of papers in the halls of the Institution of Civil Engineers and the Institution of Mechanical Engineers. The programme will include, among others, papers contributed by Admiral Sir Cyprian Bridge, G.C.B., Sir Andrew Noble, Bart., K.C.B., Sir W. H. White, K.C.B., Sir Philip Watts, K.C.B., the Hon. C. A. Parsons, C.B.; *Italy*, Colonel G. Russo; *Japan*, Admiral Kondo, I.J.N., Count Shiba, and Prof. Terano; *Germany*, Dr. O. Schlick and Prof. Flamm; and *France*, Prof. A. Rateau.

The fifteenth annual congress of the South-eastern Union of Scientific Societies will be held at Guildford on June 8–11 under the presidency of Prof. E. A. Gardner, Yates professor of archæology at University College, London. The presidential address will be delivered on the evening of June 9. There will be a reception by the Mayor on the evening of Wednesday, June 8, followed by the illumination of the Castle grounds, by the Mayor and Corporation, at whose invitation the union will meet at Guildford.

Papers will be read by Mr. Henry Bury, on the relation of the river Wey to the Blackwater and the Arun; Mr. E. A. Martin, on results of dewpond investigation; Mr. J. G. N. Clift, on the Pilgrims' Way between Farnham and Albury; Dr. W. Martin, the interpretation of maps of the sixteenth and seventeenth centuries; Dr. Vaughan Cornish, waves in sand and snow; Mr. J. W. Tutt, colour in insects; Mr. A. R. Horwood, the extinction of cryptogamous plants; and on Saturday evening, June 11 (after the congress), Mr. F. Enock will lecture on aquatic autocrats and fairies. There will be several excursions and receptions, and a loan museum, which promises to be of exceptional interest. The local secretary is Mr. Frank Lasham, 61 High Street, Guildford, who will send further particulars on inquiry.

IN the issue of the Archæological and Ethnological Publications of the University of California for March Mr. T. T. Waterman gives an elaborate account of the ritual of the Diegueño, or, as they call themselves, the Kawakipai, tribe occupying the extreme south of the peninsula. It is remarkable that they have a distinctive cultus of their own, bearing only a slight resemblance to that of their blood-kin the Mohave, or their immediate neighbours the Luiseño. These rites depend little upon their belief in spirit agency. They are based on one or other of two conceptions. The first is that in early infancy, and also at adolescence, persons of both sexes are in a condition of peculiar receptivity, children and young men and women being specially liable to external influences, both good and evil, the former being encouraged, the latter repelled by appropriate ceremonies. The second conception is the belief in the continued existence of the soul after death. Hence their mourning customs depend upon the fear of injury from the spirits of the dead, whom they endeavour to propitiate by various means, such, for instance, as by burning the goods of the dead man so that his property, in an etherealised form, may pass on for his use to the world of spirits.

DR. COMANDON gives details of the application of the kinematograph to the photography of micro-organisms in a paper published in the *Bulletin de la Société d'Encouragement pour l'Industrie nationale* (T. 113, No. 3, p. 318). Dark-ground illumination was adopted with sixteen views per second, the exposure being 1/32 of a second. Such objects as trypanosomes and spirilla in blood seem to lend themselves well to the method. It is to be noted that Mr. Duncan in this country several months ago had taken kinematograph views of the circulation of the blood in the frog's web, &c.

THE Bulletin of the Johns Hopkins Hospital for March (xxi., No. 228) contains several papers of scientific interest, notably one by Major F. Russell (Medical Corps, U.S. Army) on anti-typhoid vaccination. No untoward results occurred in a series of 3640 vaccinations, and the author believes that the procedure undoubtedly protects to a very great extent against the disease, and is a useful adjunct to other prophylactic measures. In the April number of the Bulletin (No. 229) Drs. Marine and Zenhart make the interesting observation of the occurrence of gôitre (active thyroid hyperplasia) in fish. The fish were principally pike and bass of Lake Erie, and it is of interest that, in the same district, human gôitre is prevalent, suggesting that the disease is in some way associated with water, an hypothesis long held in connection with gôitre in man.

THE Bulletins of the Sleeping Sickness Bureau for March and April (vol. ii., Nos. 15 and 16) contain the usual useful summary of investigations on trypanosomes, sleeping-sickness news, &c. The latter number contains a translation of an important memoir by Dr. Carlos Chagas on the new human trypanosome discovered in Brazil, and already referred to in NATURE (vol. lxxxi., 1909, p. 46). The parasite seems to be conveyed by a species of bug (probably *Conorrhinus megistus*, Burm.), the developmental cycle occupying a period of at least eight days. Monkeys and small animals are easily infected. The record of human cases is at present meagre; in fact, laboratory work in this case seems to have outpaced the clinical. The Bureau has also issued a "subject-index" to the "Bibliography of Trypanosomes," with corrigenda, compiled by Mr. C. A. Thimm.

SOME experiments described by Mr. G. T. Atkinson in the last number of the Journal of the Marine Biological Association will be of interest to naturalists engaged in fishery research work. In a previous number of the same journal Mr. Atkinson showed that the plaice taken from the recently exploited fishing grounds in the Barentz Sea has a much slower growth-rate than similar fish in the North Sea, and also that the males and females did not become mature until much older than in home waters. In the course of a recent voyage to the Barentz Sea in a Hull steam trawler, Mr. Atkinson brought back a number of living plaice, and marked and liberated these fish in the North Sea in the vicinity of the Dogger Bank. The experiment was highly successful, and in the course of a year about half the plaice had been recaptured. The growth was very rapid when compared with that of normal North Sea plaice, and there was a great improvement in the "condition," this always having been characteristically poor in plaice caught in the Barentz Sea and in Icelandic waters. Such experiments as these point to the possibility of a future rational regulation of the sea-fisheries. Traditional methods of the control of the industry—restriction of fishing gear, fishing apparatus, inspection, and the like—have proved to be rather futile proceedings, and investigations such as that now under notice point to the practicability of the actual cultivation of the truly sea-fishes. It is pointed out by Mr. Atkinson that not only plaice, but even the valuable halibut, may possibly be transplanted into the North Sea, and that even such comparatively expensive operations as these are likely to be would be better economy than glutting the market with plaice of such poor quality that they sell for less than one-tenth the price of good North Sea fish, while many have actually had to be used for manure.

AN important contribution to the vexed question of the cytology of yeast is made in a beautifully illustrated paper published in the *Annals of Botany* (January), by Messrs. Wager and Peniston. In general confirmation of the earlier work of Mr. Wager, the authors regard the nuclear apparatus of the cell as consisting of the characteristic vacuole, which is so prominent a feature of this organism, together with a nucleolus, which is a homogeneous spherical or oval body lying outside, but in close contact with, the vacuole, and consisting of a plastin-like substance having very little affinity for nuclear stains. The vacuole contains a clear sap and a nuclear network, and both this and the nucleolus may become more or less impregnated with chromatin. This occurs to the greatest degree during the period of highest fermentative activity, and at the same time the chromatin, previously diffused throughout the cytoplasm, disappears. Other remarkable changes in the nuclear apparatus also accompany the process of fermentation, and it is clear that the nucleus is actively concerned in the phenomenon. In bud formation the nucleolus divides amitotically, and one portion passes into

the daughter-cell, together with a portion of the vacuole and chromatin. In spore-formation the vacuole disappears, and the nucleolus then divides, forming two nearly equal portions, between which the granular chromatin is shared, and which again divide. Volutin granules occur in the cytoplasm and vacuole, and glycogen is deposited in vacuoles in the cytoplasm, and appears and disappears with astonishing rapidity under varying conditions of nutrition.

An account by Mr. F. Pitcher of Victorian vegetation in the Melbourne Botanic Gardens, which appears in the *Victorian Naturalist* (vol. xxvi., No. 11), was prepared with the three-fold object of pointing out a few specimens of trees dating back to pre-settlement days, supplying a list of native plants under cultivation in the garden, and recommending a few of these as suitable for general cultivation. Of the last, the small flowering shrubs, for the greenhouse, are *Bauera rubioides*, *Bossiaea cinerea*, *Grevillea ericifolia*, *Hibbertia stricta*, *Leucopogon virgatus*, and *Tetratheca ciliata*.

Among the remarkable instances of plant dispersion cited by the Rev. G. Henslow in a lecture addressed to the fellows of the Royal Horticultural Society, the most striking is that of *Oxalis cernua*. This is a bulbous plant, indigenous to South Africa, that has spread to the Bermudas, Canaries, and Madeira, as well as along the north and south coasts of the Mediterranean. It appears to have been originally introduced to Malta, where it now carpets roadsides, covers old walls, and is generally ubiquitous. The plant in its native habitat is trimorphic, but in Malta and along the Mediterranean only one, the short-styled, form occurs, so that propagation is effected entirely by bulbs, borne on thread-like stems that proceed from the parent plant. In rich soil the stems may also grow above ground, forming runners. Further details will be found in the journal of the society (vol. xxxv., part iii.), where the lecture is published.

The Bureau of Entomology of the United States Department of Agriculture adopts the very useful plan of issuing bulletins in which full accounts are given of the various insect pests troublesome to farmers, market gardeners, and fruit growers. Mr. Webster describes the lesser clover-leaf weevil (*Phytonomus nigrirostris*, Fab.), a fairly common European insect that appears to have got into the States some forty years ago, but is not yet very widely distributed there. It is, however, capable of doing so much damage if once it is thoroughly established that a careful watch is rightly being kept. A fungus (*Empusa* [*Entomophthora*] *sphaerosperma*) was found to destroy the pupæ. Mr. Phillips deals with the slender seed-corn ground-beetle (*Clivina impressifrons*, Lec.), which attacks recently planted maize seed in swampy, peaty soils. It is a native of the eastern States, and, of the whole genus, is the only species that lives on plants, the others being carnivorous, according to our present knowledge. Dr. Chittenden describes the parsnip-leaf miner (*Acidia fratria*, Loew.); the parsley-stalk weevil (*Listronotus latiusculus*, Boh.), an insect usually associated with aquatic or semi-aquatic vegetation, but found occasionally on terrestrial plants, and the celery caterpillar (*Papilio polyxenes*, Fab.), which attacks practically all umbelliferous plants—celery, carrot, parsley, parsnip, and so on. The larvæ are very conspicuous, and are readily picked off the plants; moreover, certain ichneumon flies destroy the insect in its pupal stage. Another bulletin, by Mr. Sanders, is devoted to the Euonymus scale (*Chionaspis euonymi*, Comstock), which can be kept in check by kerosene emulsion.

The current number of the *Zeitschrift* of the Geographical Society of Berlin (1910, No. 3) includes statements as to the aims of the projected German Antarctic Expedition by the leader, Lieut. Filchner, and by Prof. Penck, and a message of goodwill from Prof. Otto Nordenskjöld. The plan of the expedition is based on the hypothesis that the

Sketch-map illustrating the possible connection of the Ross and Weddell Seas.

Ross Sea is directly connected with the south-western part of the Weddell Sea by a narrow belt of sea separating the main area of Antarctica from the land which is assumed to connect Graham Land and King Edward the Seventh Land. This possibility, and also the view that the Antarctic land to the south of the Pacific consists only of an archipelago, must have occurred to all who carefully considered the results collected by the expeditions of Captain Scott and Sir Ernest Shackleton. The meteorological evidence and the apparently well-marked westward trend of the land which drove Sir Ernest Shackleton on to the South Polar plateau seem, however, not very favourable to the idea of the direct connection of the Ross and Weddell Seas. Indications of any such connection might also have been expected from the tidal observations of the *Discovery*.

The evidence, however, is so uncertain that all geographers will hope that Lieut. Filchner will settle the problem by direct observation. Prof. Penck insists that to determine this question is much more important than reaching the Pole. His letter closes with the announcement of a contribution by an anonymous donor of 300,000 marks.

IN the monthly meteorological chart of the North Atlantic Ocean for May, issued by the Meteorological Committee, we note with pleasure two advances of considerable importance in maritime meteorology:—(1) Synoptic charts for barometer and wind have been drawn for the Atlantic and adjacent coasts, for 7h. a.m. daily, for current dates, based upon telegraphic reports for north-western Europe, reports by radio-telegraphy from the Atlantic, and information given in the Paris *Bulletin international*. These data cannot fail to be of great use in elucidating the conditions which affect the weather changes of our own region. (2) Charts showing the temperature of the sea surface, also for recent dates, are drawn for the North Atlantic for consecutive periods of seven days, with isotherms for each 10° F. As these means correspond to those given for the land in the *Weekly Weather Report*, they will be available for tracing any connection which may exist between sea temperature and the weather over the British Islands. We also note that the area of the monthly chart relating to the Indian Ocean has been extended from lat. 15° S. to 35° S., thus embracing the region traversed by vessels trading to India, China, &c.

Cosmos of April 23 states that Chile has fallen in line with Japan, Italy, Austria, Germany, France, Russia, the U.S.A. and other countries by establishing a Seismological Service. The director is the distinguished seismologist Comte de Montessus de Ballore. Earthquake-observing stations now exist between Tacna and the South Shetlands, that is, along a meridian nearly 3000 miles in length. At five of these heavy Weichert's pendulums have been established, while seismoscopes have been installed at thirty secondary stations. Altogether 550 observers note earthquakes at 430 different localities. During six months 740 different shakings have been recorded. This means that Chile, as an earthquake-producing country, runs neck and neck with Japan. At the central station in Santiago an arrangement of P. Maccioni has been set up. We are told that this instrument responds to electromagnetic waves, and gives warning of approaching earthquakes. This installation is said to be the first of its kind. Other instruments which have been installed, besides those mentioned, are the Bosch-Ōmori and Staittesi pendulums. Instruments of the type adopted by the British Association, although they yield more records of undoubted seismic origin than any other type of instrument, do not appear to find a place in the Chilian programme.

A LARGE proportion of the *Electrical Review* for April 29 is devoted to the problem of electrically driving the machinery of cotton and other textile mills. It appears that a considerable number of mills in Lancashire and Yorkshire have recently discarded mechanical in favour of electrical driving, the usual method being to instal a separate motor in each room. There appears to be no doubt that an increase of output has been obtained, but the figures given vary considerably. Two well-illustrated articles deal with the equipment of one of the mills mentioned, and with that of a mill in Germany. In the latter almost every machine is provided with its own motor, so that no shafting is to be seen in the rooms of which views are given.

THE April number of the *Journal de Physique* contains a communication made to the Société française de Physique in December last by MM. Buisson and Fabry on the application of their interference method of measuring small differences of wave-length to the problems of solar physics. It will be remembered that in their method the light to be investigated is sent through an interferometer consisting of two plane surfaces lightly silvered, and produces a system of light and dark rings, which are focussed on the slit of a grating or prism spectroscope by means of a lens. Each ring produces in the field of view of the spectroscope two points of light the distance apart of which may be determined directly or by measurement of a photograph. When two wave-lengths are to be compared it is only necessary to measure with precision the difference of the distances of these points of light apart. On comparing the iron lines of the solar spectrum with those of the arc in air, the authors find that for some lines the solar is greater, for others less, than the arc wave-length. The solar wave-length is in every case greater, however, than that for the arc *in vacuo*. The authors conclude that if the latter differences are due to the pressure in the reversing layer of the solar atmosphere, that pressure is 5 to 6 atmospheres.

CONTINUING their physico-chemical studies on phosphorus, Messrs. Ernst Cohen and Katsuji Inouye give an account in the current number of the *Zeitschrift für physikalische Chemie* (April 26) of the solubility of ordinary phosphorus in carbon bisulphide, as the previous work on this subject by Giran indicated either the formation of a compound between phosphorus and the solvent or the formation of a new allotropic modification of white phosphorus. The purity of the materials and the method of determining the concentration of the phosphorus in the solutions were carefully controlled, and solubility determinations carried out for nine temperatures between +10° C. and −10° C. The solubility curve found furnished no indication of the compound suggested by Giran, neither was any hitherto unknown allotropic modification of phosphorus obtained.

Science Progress for April contains the two first articles, by Dr. H. W. Wiley and Dr. R. Vincent, of a general series dealing with the ethics of food. The question is one of such great national importance, and so much has been talked and written on it of late years, that it is eminently desirable to have serious and unbiased criticism published under authoritative names. Dr. Wiley's legislative crusade in the United States in favour of pure food has made him the centre of a storm of indignation and attack from the threatened interests, but he has maintained his attitude that all considerations other than scientific truth and the public welfare are to be set aside in dealing with the purity of food. No doubt there is much need of a similar crusade in this country, but perhaps the initiative should come from the general public, backed by the manufacturers of repute, rather than from the analytical chemist, as appears at present to be the case. Dr. Vincent's article on milk should be studied by all who have to do with the feeding of children. He makes a very strong point of the fact that recent developments in the milk trade have been distinctly retrogressive, and unhesitatingly condemns the boiling and pasteurising of milk.

A NEW experimental steam engine has been installed at the Glasgow and West of Scotland Technical College, and was described by Prof. A. L. Mellanby at the meeting of the Institution of Engineers and Shipbuilders in Scotland on April 26. The engine was made by Messrs. Cole, Marchent and Morley, of Bradford, and is of the horizontal, compound, side-by-side type. The high-pressure cylinder is 12 inches, and the low-pressure cylinder

21 inches, in diameter, the stroke being 30 inches. Each cylinder is fitted at each end with separate steam and exhaust valves of the drop-piston type. A steam engine uses considerably more steam than is shown by the indicator to be present in the cylinder at any part of the stroke. This loss has been generally attributed to initial condensation, but more recently the belief has been held that valve leakage is responsible for much of the extra steam used. It is hoped that the trials upon this engine may be used to supplement the work done in other laboratories in elucidating this point. Thus the Armstrong College engine has slide valves; the Manchester Municipal School of Technology engines have permitted of work being done upon Corliss, double-beat drop, and slide valves; the drop-piston valves fitted to the new Glasgow engine should therefore afford opportunities of making useful comparisons.

OUR ASTRONOMICAL COLUMN.

Cometary Orbits.—Messrs. Crawford and Meyer give new elements for Halley's comet in Bulletin No. 179 of the Lick Observatory, based on observations made on September 17 and December 16, 1909, and February 28, 1910. The perturbations due to Mars in January were found to be ineffective, and the time for perihelion is finally given as April 19·67760 G.M.T.

When it became known that other computers found great difficulty in computing an orbit for comet 1910*a*, Miss Levy and Mr. Meyer, of the Berkeley Astronomical Department, decided to test a method devised by Prof. Leuschner. For this purpose photographic observations secured by Dr. Curtis, with the Crossley reflector, on February 1, 2, and 5, were selected, and a very satisfactory result obtained from the direct solution for an approximate orbit. Other observations were then considered, covering the period January 18 to March 13, and final parabolic elements calculated by the same method. These are given, with an ephemeris, in Bulletin No. 179, and the ephemeris indicates that the comet is still a little west of the Great Square, and is very faint. Observations by Dr. Aitken on April 13 gave corrections of $-0·9s.$ and $-4''$. Elliptic elements for Daniel's comet, 1909*e*, published by Sturla Einarsson and R. Young in the same Bulletin, give a period of 6·48 years.

Recently published elliptic elements for comet 1910*a* give periods of 202·6 and 41 years respectively.

Measures of Double Stars.—No. 175 of the Lick Observatory Bulletins contains the measures of 136 double stars made by Mr. Olivier with the 12-inch and 36-inch refractors of the Lick Observatory. Generally, the stars measured are neglected pairs in the southern hemisphere, such as can be observed from lat. 38° N., or pairs which show signs of motion. Eleven new doubles are included, and of the 136 stars observed, 15 are separated by less than $1''$, 56 between $1''$ and $2''$, and 30 between $2''$ and $3''$. It is interesting to note that the 12-inch refractor was generally employed, and leaves nothing to be desired as regards definition; a power of either 500 or 625 was always used, and doubles down to $0·6''$ in distance could be readily measured.

Maximum of Mira, 1909.—*Astronomische Nachrichten* No. 4403 contains two notes on the most recent maximum of Mira. The first is by Herr May, of the Kasan Observatory, who finds that the maximum took place on September 9, 1909, the magnitude being 3·14. The second is by Herr Landwehr, Münster, and gives September 4·7 and 3·15 respectively. According to Guthnick's ephemeris, the epoch of maximum was September 6·9, and the magnitude should have been 3·27.

Parallax of the Planetary Nebula G.C. 4373.—From a photographic determination, Dr. Bohlin finds that the parallax of the planetary nebula G.C. 4373 (H iv. 37) is $-0·170'' \pm 0·042''$, and the correction for the aberration constant is $-0·043'' \pm 0·042''$ (*Astronomische Nachrichten*, No. 4406, p. 232).

HALLEY'S COMET AND METEOROLOGY.

Proposed Meteorological Observations during Progress through the Tail of Halley's Comet.

The International Commission for Scientific Aëronautics had arranged a series of ascents of kites and *ballons-sondes* for May 11–13, but seeing that it is possible that the earth may pass through the tail of Halley's comet on May 19, the members of the commission have agreed to postpone the ascents to May 18–20. A circular from Prof. Hergesell, the president of the commission, gives particulars of the proposed ascents, the times mentioned being as follows:—May 18, 7 a.m. and 10 p.m.; May 19, 2.30 a.m. and 7 a.m.; and May 20, 7 a.m. Observations should be made at the earth's surface, and *ballons-sondes* should be sent up about half an hour before these times, so that the balloon for the principal ascent should reach its greatest height about the time when the earth passes through the tail of the comet; one ascent should also precede, and one should follow, the principal ascent by precisely similar intervals of time.

Messrs. Assmann and Teisserenc de Bort suggest that it might be possible to carry out ascents of manned balloons as well as of *ballons-sondes*, and it is suggested that the aëro clubs of different countries should cooperate in the observations. A letter has also been sent out by M. Teisserenc de Bort describing the apparatus he has designed and used for several years for collecting samples of air from great heights. The use of Aitken's dust counter is recommended in connection with the ascents of manned balloons, and similar observations should be made at the earth's surface. Though it is unlikely that the passage of the earth through the tail of a comet will cause any measurable change of temperature in the upper air, yet it is felt by those engaged in the investigation of this subject that such a rare occurrence should not be allowed to pass without some notice.

Meteors from Halley's Comet.

Mr. Denning writes:—

"During the first week in May the weather was unsettled and stormy, and Halley's comet could not be well observed, nor could its supposed meteoric shower from Aquarius be suitably watched. Several meteors were seen, however, at places where the sky was clear or partially so, and they were directed from the radiant point of the comet, though no brilliant display of these phenomena seems to have been witnessed in England.

"There is a probability of an abundant display of meteors on the morning of May 19, when the earth may encounter the comet's tail, but this is doubtful. The sky should be carefully watched, however, on the morning named with the view of observing any meteors or peculiar auroral effects that may be visible.

"A rich display of meteors is reported to have been witnessed at Cape Town on the morning of May 7 between 2 and 5 a.m. There was no very active shower seen in England on the date mentioned, and further particulars will be awaited with interest.

"A fireball, presumably connected with Halley's comet, was noticed at Guernsey and other places on the morning of May 3 at about 2.50 a.m. As viewed from the Channel Islands, it had a long path ascending from just under β Pegasi to under β Cassiopeiæ, with a duration of four seconds.

"The real path of the meteor was from sixty-seven to forty-six miles in height, and its position over the English Channel from near Dieppe to south-west of the Isle of Wight, and its course, of some 137 miles, was traversed at a velocity of about thirty-four miles per second. This is a slower rate of speed than calculation implies to the Aquarids, but atmospheric resistance evidently moderated the meteor's native velocity. From the south coast of England—especially Sussex and Hampshire—the object must have been a splendidly luminous one, presenting a very long and graceful flight along the southern sky, but I have not hitherto received any observations from this particular part of the country.

"That the meteor was really a fragment of Halley's comet cannot be absolutely proved, but it is suggestive and significant that it was directed at the correct date from the computed radiant of the famous comet now visible. It is hoped that further observations will be furnished of this and of any similar objects which made their apparitions at the important time when the earth passed near the cometary orbit."

Observations of Halley's Comet.

Mr. Gustave Gillman, writing from Aguilas on May 2, says:—

"I enclose a chart showing Halley's comet as seen at 4 a.m. this morning, and the extent to which the tail could be traced, *i.e.* to slightly beyond θ Piscium. I have seen it on two previous days, but there were too many clouds to be certain of the extent of the tail. I could see no bifurcation."

Dr. A. C. Jordan writes:—

"At Broadstairs yesterday morning, Sunday, May 8, I had a good view of Halley's comet. There was a slight mist over the horizon, but I was able to keep the comet in view from 2.50 until 3.25. It was easily visible to the unaided eye, and was brighter than Algenib (γ Pegasus), the nearest bright star. Through an ordinary binocular the contrast between this clearly defined star and the nebulous-looking comet was very well marked. Toward 3.30 the approach of day rendered this part of the sky so bright that it was no longer possible to keep the comet under observation."

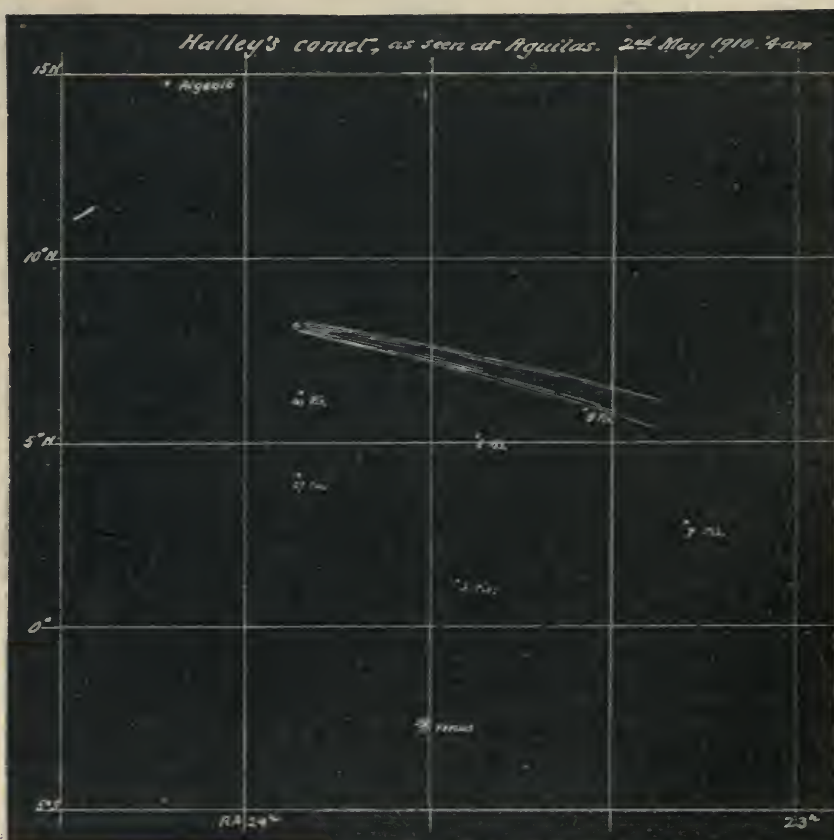
Further details as to the appearance of Halley's comet, as seen at Malta with naked eye and field-glasses, are sent to us by Mr. C. Leach. The comet was seen by several people, and Mr. Leach found that both nucleus and tail were easily picked up without optical aid on April 24, 25, 26, 27, and 30. He states that it was seen best between 3.45 and 4 a.m., and faded in the dawn at 4.10 a.m. The tail is described as lengthening and getting more elegant, its length being a little greater than the distance separating the comet and Venus; this would mean an apparent length of about 7° or 8°, and an actual length of about ten million miles. The nucleus, on April 30. is described as being sharply defined and at the very beginning of the comet, its brightness being about equal to that of α Andromedæ (mag. 2·1). A rough sketch sent by Mr. Leach represents the comet as having a straight, narrow, bifurcated tail, reminding one of the Paris drawing of the great comet of 1843.

Mr. Gruning, of Ealing, reports having seen the comet on several occasions with field-glasses, and twice, on May 7 and 8, with the naked eye. To know where to look for it the first time, he observed Altair emerge from behind a chimney the previous evening, and then, by a simple calculation, found the time, and the position with regard to the same chimney, for the comet's appearance next morning.

Mr. Bellamy reports to the *Daily Mail* that the comet was observed at Oxford University Observatory from 2.40 to 4 a.m. on May 9. It was visible without a telescope, and was estimated to be about as bright as a second-magnitude star. Observations were also made at Greenwich with the altazimuth.

According to a correspondent of the *Daily Chronicle*, observations at the Milan Observatory, on May 8 or 9, showed a straight tail some twenty degrees in length, or, actually, about 14½ million miles long. A tail of this length would probably reach to the earth at the time of transit.

Observations of the comet during its near approach to Venus on May 2 were prevented, at English observatories, by bad weather, so that the possible magnetic-attraction phenomena mentioned by Prof. Birkeland could not be looked for.



Halley's Comet as seen at Aguilas on May 2, 1910, at 4 a.m.

In an address delivered on Monday evening at the annual meeting of the Victoria Institute, Mr. Crommelin directed attention to one or two possible references to the comet in historical writings, citing the "almond rod" mentioned in Jeremiah i., 11–14, as a possible allusion to the comet's tail seen rising before the head. He also directed attention to the improbability of our being able to detect the presence of the tail should the earth pass through it. In suggesting that the comet would afford a good display during the evenings of the last ten days in May, he warned his hearers not to expect such a spectacle as was afforded by the great comet of 1882.

In the *Atti della Pontificia Accad. Romana dei Nuovi Lincei* (February 20) Dr. Pio Emanuelli points out that the velocities of Halley's comet at perihelion and aphelion are often exaggerated, and, using Mr. Crommelin's elements, he determines the true values. These he finds to be 55 km. and 0·9 km. (35·6 and 0·56 miles) per second

respectively. Dr. Smart, using Pontecoulant's elements, obtained 31·3 and 0·62 miles per second.

Messrs. Cowell and Crommelin have been awarded, jointly, the Janssen medal of the Société astronomique de France, for their precise determination of the orbit of the comet for this present apparition.

A number of interesting representations of comets, some certainly of Halley's, are reproduced in the May number of the *Bulletin de la Société astronomique de France* from the "Theatrum Cometicum" of Lubienietz. Each drawing is accompanied by a note explaining it, and directing attention to contemporary occurrences; in concluding the article, M. Flammarion suggests that great comets were of more frequent occurrence in early times than they are now.

A NEW TELEPHONE RELAY AND ITS APPLICATIONS.[1]

EVER since the introduction of the telephone a real need was felt for a telephone relay, for the distance over which telephones could be used was found to be comparatively limited. Edison, soon after his invention of the carbon button transmitter, caused an electromagnet to act upon the iron diaphragm, and thus turned it into a relay, but it was not a success. Hughes (Proceedings of the Royal Society, vol. xxvii., p. 362, 1878), in his paper before the Royal Society in 1878, describing his extremely delicate microphones, stated that a telephone receiver, if included in the microphone circuit and placed upon the resonant board, caused a continuous sound to be produced. It follows, he said, that the question of providing a relay for the human voice in telephony is thus solved. Unfortunately, it was not solved; he had shown how to make a relay that would magnify a noise or musical note, but not one that would intensify articulate speech.

Sir Oliver Lodge (Journal of the Institution of Electrical Engineers, vol. xxvii., p. 799, 1898), in a paper read in December, 1898, before this society, described a relay consisting of three or four reeds or tuning-forks, each carrying carbon contacts and working in series with one another. Each reed was arranged to resonate to one particular musical note, and when this note was passed through the string of relays it was multiplied in power to a considerable extent. An instrument of this character, however, is not effective in intensifying speech. An articulate relay must have its vibrating parts damped, or, in other words, possess no resonating properties; it is therefore far more insensitive to sound than one that is arranged to resonate to one particular note.

The invention of the powerful granular transmitters of the Hunning type stimulated further efforts to obtain the speaking relay, and some progress was made with this type of microphone, particularly in America. I will not describe these relays further than to say that they consist in combining the telephone receiver and the granular carbon transmitter; both of these are designed as efficiently as possible, and in some cases automatic means are provided to shake up the granules should they become packed. These relays are only partially successful. Their advantages are not decisive. They require relatively powerful currents to work them; that is to say, when the telephone currents become sufficiently feeble to require their services, it is at this point that the carbon instrument fails to work. The telephone relay to be successful has to magnify in a continuous manner varying currents that are too feeble to affect properly a Bell telephone receiver. Such currents would be of excessive weakness, say of the order of the one one-hundred millionth of an ampere (10^{-8} ampere), and the mechanical movements produced by such currents, which have in their turn to bring about the increased electrical changes, are therefore microscopic in dimensions.

The author's telephone relay has had to be developed along quite new lines. It takes as its basis the researches of J. J. Thomson, Earhart, Kinsley, and others, with regard to the flow of electrons across a microscopic air-gap between two conducting surfaces at different potentials (see "Conduction of Electricity through Gases," J. J. Thomson, chap. xv.). Earhart made a series of experiments on the difference of potential required to produce sparks the length of which is comparable with the wave-length of sodium light, and he found that when the distance between the metal electrodes falls to less than about 3×10^{-4} cm., the spark potential falls off rapidly with the distance, and seems to become proportional to the distance; that is to say, when the electrodes are placed very close together, within a distance such that the average intensity of force F between the electrodes reaches a value of about a million volts per centimetre, the discharge or

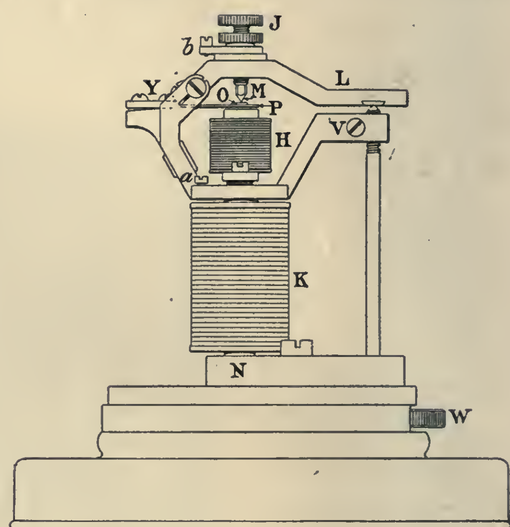


FIG. 1.

current passing is determined by the condition that F, which is V/d, reaches this value (where V is the potential difference and d the distance between the electrodes). If the metallic circuit of a dry cell be interrupted by a minute opening or space of the order of 5×10^{-7} cm., the metal at the point of interruption being platinum, the current will continue to flow round the circuit and across the opening, and any slight alteration in the length of the space, which I shall call the conduction space, will vary its resistance and greatly affect the value of the current that flows round the circuit. This conduction space is therefore exactly what is wanted for the current-varying device of a telephone relay, where microscopic mechanical movements are to be transformed into large current changes. The dimensions of the conduction space are so small that it is difficult to ensure and maintain it by direct mechanical means. The current that flows across the space was therefore made to do its own adjustment, very much in the same way as the current that passes through the arc of an arc lamp is made to strike and maintain the length of the arc.

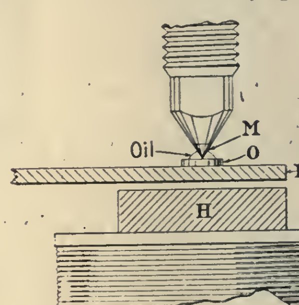


FIG 2.

Fig. 1 is a side view of the instrument with the brass cover removed. N is a permanent magnet, continued by soft iron poles right up to, but not touching, the "invar" steel reed P. Round the soft iron pole extensions are wound the two sets of coil windings H and K. The telephone currents to be magnified circulate round the winding H, and thus, by varying the magnetism, set the reed P in vibration. M, O are the top and bottom metal contact-pieces, which are opened to an infinitesimal degree to form a microphone by the fine adjusting screw W and

[1] From a paper read before the Institution of Electrical Engineers on May 5 by Mr. S. G. Brown.

y the action of the local current passing through the ontact and round the winding K. It is by the action of he local current operating through this winding that the onduction space is formed and afterwards maintained. o good is the automatic adjustment that the instrument nay be turned upside down, producing hardly any noticeble alteration in the value of the local current and withut any effect on the working of the relay. The reguating winding K must not act when traversed by the apidly varying telephonic currents; this is brought about y surrounding the iron under the coil by a closed circuited

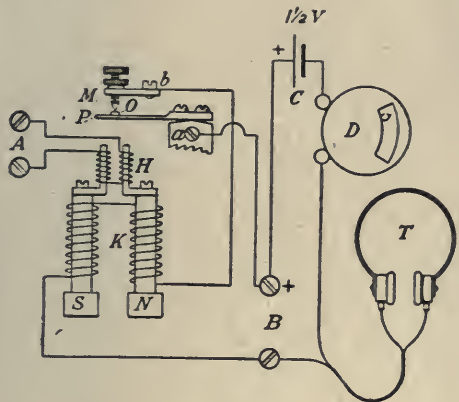


FIG. 3.

copper sheathing. Eddy currents set up in this sheathing by mutual induction destroy the self-induction of the coil.

Fig. 2 is an enlarged view of the reed P and the contact-pieces M, O. In the present instrument the contact is made between metal pieces of hard osmium iridium alloy. The top contact is pointed; the lower one is flat, and is soldered to the reed; both are polished, and work under a small drop of thin oil.

In earlier instruments the lower contact O was carried by a thin iron disc; the relay was then very susceptible to outside noises. For this reason a reed is now used; it exposes such a small surface to the air that it is practically unaffected by extraneous sound.

Fig. 3 shows the connections of the relay. C is a dry cell (this is the normal voltage, which is as high as it is

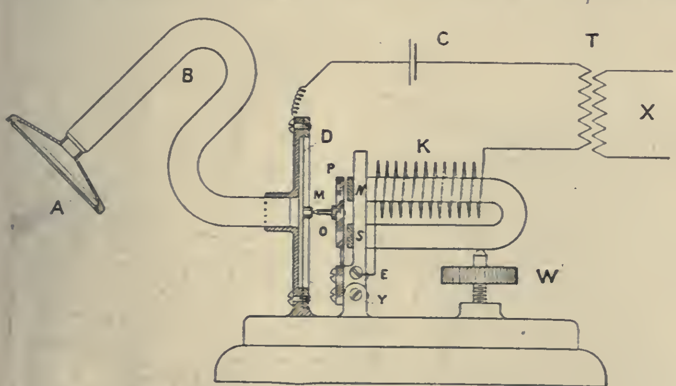


FIG. 4.

desirable to employ), K the low resistance regulating winding, T the receiving telephone or telephone head-piece of approximately 40 ohms resistance, D is an amperemeter or current indicator; when the microphone contact is opened so as to cut down the local current to half its maximum value, the relay is usually at its best adjustment. The telephone currents to be magnified enter by the terminals marked A, and circulate through the winding H.

The relay will magnify the very feeblest telephone currents. Speech or signals that are too faint to be heard in the ordinary Bell receiver may be heard clearly through the relay. If a watch be held against the ear-piece of a Bell telephone the induced currents produced when passed through the instrument will reproduce the ticking in the receiver attached; this is a severe test.

This property of magnifying feeble telephone currents has made it particularly useful in wireless telegraphy. On replacing the telephone by the relay the increased sensitive-

FIG. 5.—The Telephone Relay.

ness thus obtained doubles the distance over which it is possible to receive signals. Its utility in this direction has been tested, among others, by the Admiralty and the Post Office. In a wireless receiving station, messages, the very existence of which was not even suspected, owing to their extreme feebleness, when listened for under former conditions with the relay in circuit, were easily read. At the invitation of Mr. Marconi I took two instruments to the Haven Hotel, Poole. In one of the tests (Clifden, in Ireland, sending with the Marconi musical spark) the signals were heard in the telephone, directly connected, as a faint but clear and pleasing series of musical notes; but with two relays joined to the system and working in series the notes were rendered so loudly as to be heard clearly by everyone in the room, and an operator listening at a distance of several yards from the instrument could have deciphered the message. The relay is not easily affected by extraneous noises and vibration. It can thus be carried on board ship and worked in all weathers.

As regards its utility on ordinary telephone lines, speech may be magnified many times in loudness without perceptible loss in the articulation, and it will work with large currents to a point at which the Bell receiver in its local circuit is responding with uncomfortable loudness. In experimenting over a 20-lb. standard cable and speaking only one way, it has been proved that, when the relay is applied, thirty miles may be added to any length through which it is possible now to speak direct. For instance, supposing the length of the core for direct speaking be twenty miles, this may be increased to fifty miles for the same loudness and approximate clearness when the relay is in circuit, either as a single repeater at the end of the first twenty miles or as a receiver at the end of the fifty miles.

These tests prove that the telephone currents must be

increased in strength to the extent of something like twenty times. If still greater magnifications are required than can be obtained with one relay, the simplest method would seem to be to employ two relays working in tandem. Their combined power would then be 400 times. In the majority of cases it is not necessary to add to the natural electrical damping of the reed, but if a piece of soft rubber be made to touch it, the voice can be transmitted with greater clearness even than if the conversation were taking place ordinarily in a room. This may be due to the complete absence of echoes.

FIG. 6.—Telephone Relay in brass case with upper arm raised for cleaning the contents.

By means of the local regulating winding (see Fig. 2) the metal contact M, O is transformed into the most exquisitely delicate microphone, more sensitive, there is every reason to believe, than could be formed by light pressure between carbons. Such a microphone has rendered possible the construction of an electric stethoscope, an instrument by the use of which the sound of the heart or other internal organs may be greatly magnified. This, I have been informed, may render it possible to detect in the earlier stages heart disease, aneurism, and gall-stones.

Fig. 4 is a diagrammatic illustration of the stethoscope. A is the front part, and consists of a shallow brass cell faced by a thin ebonite diaphragm. A is placed upon the part of the body to be examined, say the heart; the beating of the heart is communicated to the ebonite diaphragm, then to the air inside the tube B, and thus the metal diaphragm D is set in vibration. M, O, as before, are the osmium-iridium contact-pieces. M is mounted on the diaphragm, and O on the steel reed P. The magnet N, S and the reed are carried by a brass frame E, which is pivoted or hinged at the lower support Y. The conduction space is formed between the contacts M, O by turning the fine adjusting screw W, and by the automatic action of the local current from the cell C flowing through the winding K and round the magnet. T is a special telephone transformer of equal windings of, say, 20 ohms resistance in the primary and in the secondary.

The electric stethoscope in its present form causes the sound of the heart to be three times as loud as in the ordinary stethoscope. This is scarcely sufficient for practical purposes; but if a telephone relay, such as I have previously described, be attached to the wires x of the transformer, the two instruments combined raise the intensity of the sound some twenty times and more, and this is ample for all ordinary purposes. The sound to be examined is picked up by the end of the tube A, and is heard in the telephones of a head-piece attached to the relay.

At the invitation of two physicians I took the complete instrument, stethoscope and relay, to the London Hospital, where it was tested upon a number of diseased heart cases. Not being a doctor myself, I cannot discuss the merits of the instrument with regard to its medical value, except to say that it seemed to render diagnosis particularly easy and revealed some phenomena only previously suspected. From a sound-magnifying point of view the general results were as follows. When the instrument was applied directly to the heart the sound of the beats given out in the telephones was uncomfortably loud, and easily heard by the patient and all those that stood round, and this even i

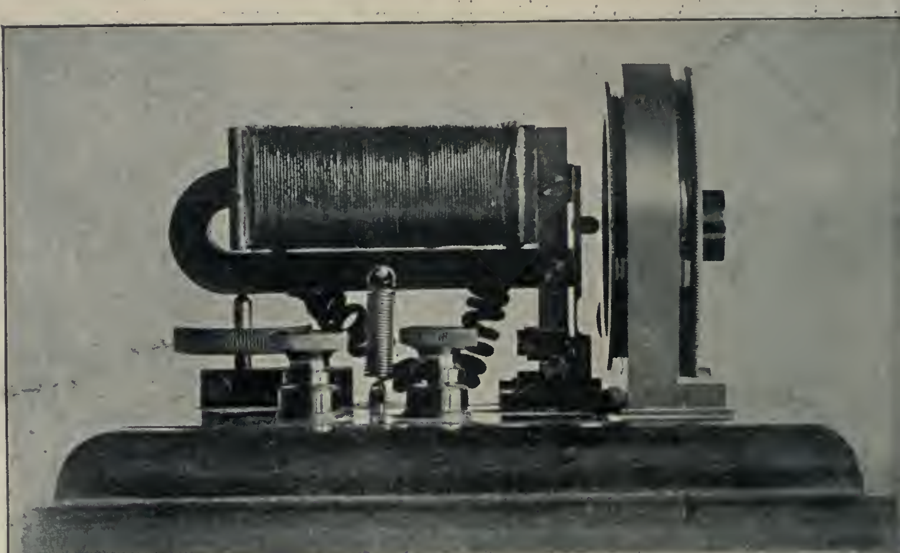


FIG. 7.—Electrical Stethoscope.

the telephones were in position on the head of the operato The stethoscope as used increased the heart-beats to th almost complete exclusion of the shriller or breathi

sounds. This has been brought about by mechanically tuning the disc D and the reed P of the telephone relay to the corresponding low note, and by a proper proportioning of the volume of air enclosed by the tube B. On other occasions, during private experiments, the instrument has been tuned so that nothing but the breathing sounds were audible; the passage of air through the lungs was heard as the roar of the wind through a forest of trees. This power of discrimination should be of service in allowing the independent examination of various organs of the body.

Replacing the telephone head-piece by a transformer, the stethoscope has been joined to the telephone service in my house, and, for the sake of experiment, the sound of the heart has been transmitted over several miles of telephone line to doctors in various parts of London and to other friends who were interested. All of them reported that the sounds received in the telephone were as loud and clear as when heard locally. The line, therefore, does not appear to produce much loss or distortion. This trial proved that it is now possible for a specialist, say, in London, to examine a patient, say, in the country, stethoscopically, and to arrive at a correct diagnosis.

The instrument must of necessity, to replace the ordinary stethoscope, be more sensitive to sound than the human ear. This is proved by slight noises made in the room being heard in the telephones as loud noises. In consequence of this, the apparatus is padded and guarded, so far as is possible, from all outside disturbances, and the patient should be examined in a quiet room. If the instrument is provided with a small funnel in place of the tube B, it will pick up and magnify the slightest sound, and ordinary speaking may be increased to a deafening shout in the telephone. Such an instrument, when properly constructed for the purpose, may be of use to those who are afflicted with deafness.

FIG. 8.—Electrical Stethoscope and Telephone Relay ready for use.

The relay has been used on the electrophone system, and by its aid, damping the reed with a piece of rubber, the speaking and music from the theatres are rendered with loudness and greater clearness than it is possible to have on the telephones supplied by the company, and by adding a loud speaker with trumpet the sounds can be heard in the room.

THE IRON AND STEEL INSTITUTE.

THE annual general meeting of the Iron and Steel Institute was held on Wednesday and Thursday, May 4 and 5, at the Institution of Civil Engineers. The retiring president—Sir Hugh Bell—inducted the president-elect, His Grace the Duke of Devonshire. After presentation of the Bessemer medal to Mr. E. H. Saniter, of Rotherham, for scientific services rendered to the iron and steel industry, the Duke of Devonshire gave his presidential address. In the course of a long and detailed account of the rise and progress of the coal, iron, and steel industries in this and foreign countries, the president also reviewed the social and economic conditions over the period from 1869, when the institute was founded under the presidency of the seventh Duke of Devonshire, to the present time. Conditions of work are now safer and more sanitary; wages are better, and working hours lighter. Housing is better, and a host of improvements in traffic, lighting, education, and public assistance have made for the comfort, health, and enlightenment of the people. Taking increase in wages paid to the worker, and also the increased spending power of these wages, into account, His Grace quoted statistics showing a net increase, for the period mentioned, of 90 per cent.

The meeting then proceeded with the reading and discussion of papers, thirteen of which were presented. Owing to lack of time, several of these had to be taken as read. In the case of those actually presented at the meeting, the time allowed to the author for explaining the contents of his paper was in each case ten minutes. The institute is to be congratulated on the high standard and importance of the papers presented, but we think that it will be difficult to maintain this standard unless in future more time is placed at the disposal of the authors at the meetings.

Mr. D. Selby Bigge, in a paper on the development in the production of electric power, pointed out that considerable progress had been made in the cost at which electricity can now be produced in iron and steel works having at their disposal waste gas, waste heat, and waste steam. One of the means by which low cost of production has been attained is the mixed pressure steam turbine. Such turbines differ from exhaust steam turbines in that the latter are intended to derive their supply of steam from engines which run continuously, such as blowing engines and pumping engines. Mixed flow turbines may work with reciprocating engines which are only in action intermittently. A continuous supply of steam is obtained for the turbine by adopting a form of regenerative accumulator, the action of which is as follows. The exhaust steam is taken from the engines and mixed with water, both coming to the same temperature. Supposing, now, a drop in pressure of $1\frac{1}{2}$ to 2 lb. per square inch to take place in the accumulator, owing to the exhaust steam supply being cut off, the water in the accumulator at once gives off vapour, thus keeping up the supply to the turbine. Any sudden rushes of exhaust steam from the engine are utilised in storing heat in the accumulator, and will be drawn on for supplying the turbine during the next pause in the supply of exhaust steam.

The turbine is built in stages, one set being designed for the working pressure of the existing boilers, and so constructed as to give off the full output of the turbine upon live steam when required; the other set is designed for the utilisation of exhaust or low-pressure steam received from the accumulator in the case of engines working intermittently, or direct from the exhaust of engines running continuously. The low-pressure end of the turbine is also designed to give out the full rating or output upon low-pressure steam alone. Should the full supply of exhaust steam fail from any cause, live steam is automatically admitted to make up the temporary deficiency in the exhaust steam available. Further, high-pressure steam is admitted when required to the high-pressure stage without the intervention of a reducing valve. To secure efficiency, a high vacuum must be secured, and the selection of a suitable condenser must be carefully considered. Various types of turbines, gas engines, and electrical installations for steel works are described by the author in the paper. The adoption of any particular system must obviously depend on the circumstances; each case must be considered on its merits. It is of interest to note that the Duke of Devonshire in his address cited the economy effected last year at the Barrow Works, where the installation of eight gas engines to replace the steam-driven engines produced an immediate saving of 1500 tons of coal weekly.

An interesting paper on the cutting properties of tool steel was contributed by Mr. Edward G. Herbert, of Manchester. It is well known that a high-speed steel tool with

a light cut and a high speed will keep its sharp edge better than a carbon-steel tool. The durability of all steels, without exception, is very low at low speeds under light cuts; and increases as the speed is raised, the durability being measured by the amount of metal cut away before the tool becomes blunt. The engineer usually requires the steel that will remove the greatest amount of metal per hour without requiring too frequent sharpening, and it is useful to express the "duty" of a tool steel by the product of metal removed and corresponding cutting speed, thus obtaining a quantity which is proportional to the time rate of removing metal and to the durability of the tool.

To account for the fact that an increase in the cutting speed is accompanied by an increase in the durability of the tool, it has been suggested that the evolution of heat, and consequent rise in temperature of the cutting edge, may be the influencing factor, and experiments are described in the paper giving confirmation of this view. In these experiments heat was applied artificially to the tool while cutting by means of hot water, and tests were made at different temperatures. A law has been deduced from the results which may be stated thus: for constant durability of the cutting tool the speed varies as the cube root of the product of area of cut by thickness of shaving. Experiments were also made on the effects of temper and of the percentage of carbon on the durability of carbon steel, and on the effect of the cooling process in the case of high-speed steels.

Prof. J. O. Arnold, in his paper on uniform nomenclature of iron and steel, earnestly pleads with metallographists strongly to support Prof. le Chatelier in his effort to abolish personal names for the constituents of steel. Mr. Sydney A. Grayson, of Birmingham, gives the results of some recent investigations on case-hardening, from which it appears that it is necessary to classify case-hardening compositions both by the carbon per cent. obtained in the "case," and also by the graduation of the carbon diffusion, which is best shown graphically. This classification is necessary on account of one composition being more suitable for certain kinds of work than another. A high carbon "case," such as 1·10 per cent. carbon, would be very efficient for the kind of work where the pressure was fairly constant, such as a plain bearing, but it would be very unsuitable and inefficient for parts which had to resist repeated shocks, because of the strong tendency of the high carbon "case" to chip, or even to peel off. It is advisable, where all kinds of case-hardening have to be done, that two compositions be used, one of them to produce a high carbon wearing surface, and the other to produce a medium carbon wearing surface.

Mr. C. A. M. Smith, of East London College, adds to his previous work on the elastic breakdown of certain steels an investigation of the possibility of non-axial loading occurring in test-pieces held in the testing machine on spherical seats, and shows that, in the case of a 50-ton machine in which the radius of the seats is $1\frac{1}{2}$ inches, the eccentricity may amount to 0·15 inch, with a coefficient of friction of 0·1. The ratio of maximum to mean stress would then be at least 2·2, and in one test where eccentricity was known to exist, a ratio of 2·96 was found.

A GEOLOGICAL SURVEY OF COLORADO.[1]

THE State of Colorado is one of the most famous in the history of American mining, but though its Geological Survey was created in 1872, and has included on its staff some distinguished men, it has done comparatively little, for it remained practically without funds until 1908. The Survey has now been provided with an annual subsidy and a staff, Mr. R. D. George being State geologist with sixteen assistants. Its first annual report has been issued, and shows that the Survey has been organised on sound lines, for it contemplates cooperation with the Federal Survey and private local geologists, and the advancement of local education by presenting a collection to illustrate the mineral wealth of Colorado to every high school in the State.

The first volume consists of five valuable memoirs upon the geology of Colorado, illustrated by geological and topographical maps. The stratigraphical geology of the foothills is described in a memoir by Mr. J. Henderson. They consist of a foundation of Archean and Algonkian rocks, which are covered by a long succession of sediments, representing continuous deposition from the Carboniferous to the Laramie, at the end of the Cretaceous. This succession consists of 10,000 feet of strata, partly marine and partly terrestrial, and apparently all conformable. The beds were laid down in the course of a slow subsidence of the country, so that the higher members of the series overlap one another on to the older rocks to the west. After the Laramie there was a break, and the chief Cainozoic deposits are of Miocene age.

The other memoirs deal with economic geology. Each is well arranged, and accompanied by a useful bibliography. Mr. R. D. George and Mr. R. D. Crawford contribute an outline survey of the Hahns Peak mining field, thirty miles from the railway terminus at Steamboat Springs. Hahns Peak itself is a porphyry laccolite, once covered by Cretaceous rocks. The goldfield is one of those interesting cases in which no certain source has been discovered of the gold in rich placer deposits. The lode mines hitherto found yield silver-lead ores, and their working has not been remunerative. The popular local belief as to the source of the gold is that it has come from the porphyrites, of which the junction with the sediments is generally mineralised; but it has also been attributed to conglomerates at the base of the Dakota formation and to pre-Cambrian metamorphic rocks.

Mr. George contributes a valuable memoir on the tungsten area of Boulder County, accompanied by notes on the intrusive rocks by Mr. R. D. Crawford. It includes a brief account of the tungsten deposits throughout the world, and of the technical uses of the metal. The Boulder tungsten field consists of gneiss of sedimentary origin, which is seamed by dykes of pegmatite, which the author claims, in this instance, to be an intrusive rock and not a pneumatolytic product. There are also dykes of latite, a rock intermediate between trachyte and andesite. The tungsten ores are mostly found in the granite; the veins in gneiss are narrower and less profitable, as that rock forms less open channels when disrupted. The veins are very irregular in arrangement, but are generally steeply inclined. The tungsten was introduced by four successive depositions. There has apparently been considerable difficulty in the concentration of the ore, owing to its extreme friability, and the author suggests the use of magnetic methods, which have proved successful in Cornwall. This report is illustrated by a series of plates, of which six are especially useful, as they show the various types of ores.

The last report is by Mr. H. B. Patton, on the Montezuma district of Summit Country. The rocks of this mining field are the Archean schists and gneiss of the Front Range, injected by acid and diabase dykes. The ores are replacement veins composed of quartz containing lead, zinc, and a little copper and some silver and gold. Unlike some Colorado mining fields, descending water appears to have had very slight effect upon the ores, and there has been little secondary sulphide concentration. The porphyritic dykes are of Cretaceous date, and the ores were introduced later than the formation of any rock in the district. The distribution of the ores appears to be quite independent alike of the dykes, pegmatite veins, and cleavage. The ore bodies lie along joint planes, on which there may have been some movement by strike faults. There is, however, no direct evidence that the ores were connected with faulting, for the cross-faults are barren, and the joint planes may have been mineralised simply because they were planes of weakness, which offered the ore-bearing solutions the readiest channel to the surface.

J. W. G.

[1] Colorado Geological Survey. First Report 1908. By R. D. George. Pp. v+243; 22 plates, 4 maps. (Denver, 1909.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Mr. C. L. Boulenger, of King's College, Cambridge, has been appointed to the lectureship in zoology rendered vacant by the resignation of Mr. Leonard Doncaster.

Dr. Leonard Parsons has been appointed assistant lecturer in pathology and bacteriology to succeed Dr. Leonard Mackey.

Cambridge.—On account of the death of his Majesty the King all invitations issued for the laying of the foundation-stone of the New Museum of Archæology and Ethnology are cancelled.

The increased entry in the University is shown by the fact that on May 3 seventeen undergraduates matriculated. This brings the total number of students for the academic year 1909–10 up to the present date up to 1217, as contrasted with 1163 at the same date last year.

The Special Board for Geographical Studies has reported on the financial position of the Department of Geography. The University makes an annual grant to the Board of 200*l.*, and the Royal Geographical Society makes a grant of a similar sum. This latter sum is primarily assigned to the stipends of a university lecturer in regional and physical geography and a university lecturer in surveying and cartography, who are called the Royal Geographical Society's lecturers in their respective subjects. The department has, however, grown, and the Special Board is of opinion that a further 200*l.* a year is the smallest additional sum with which it will be possible to make adequate provision for the study of the subject. The Board is of opinion that further accommodation for the department is urgently required. Application has already been made for the assignment of a lecture room, a laboratory, and some private rooms in the block of buildings now under construction. In order that geography may assume its due place in the studies of the University the Board looks forward to the appointment of a professor and of a reader with three lecturers under them.

Mr. Cyril Strickland, of Gonville and Caius College, has been appointed assistant to the Quick professor in place of Mr. H. B. Fantham, who has resigned the post.

Dr. T. G. Longstaff will deliver a lecture in Cambridge on Thursday, May 19, at 5 p.m., on "Glacier Exploration in the Eastern Karakoram Himalayas." The lecture, illustrated by lantern slides, will be given in the Sedgwick Museum.

Mr. E. Torday will give a lecture on his investigations among the Bushongo of the Kasai basin on Thursday, May 19, at 8.30 p.m., in the Museum of Archæology and Ethnology.

Oxford.—Dr. G. C. Bourne, Linacre professor of comparative anatomy, and Mr. E. S. Goodrich, fellow of Merton College, have been appointed representatives of the University at the eighth International Congress of Zoology, to be held at Graz in August next.

Mr. W. Fischer Wilkinson has been appointed principal of the newly constituted School of Metalliferous Mining (Cornwall). Mr. Wilkinson's duties will not commence until the next session in September, but he has already associated himself with the governors in drafting the prospectus of the new school, which will be issued shortly. Mr. J. J. Beringer, who for twenty-eight years has been principal of the Camborne Mining School, will join the staff of the School of Metalliferous Mining and will take charge of the metallurgical subjects.

Science announces that Johns Hopkins University has received an offer of 50,000*l.* from the General Education Board for the purpose of aiding the University in its efforts to put into operation certain extensions and improvements that have been under consideration for several years, including the erection of new buildings. This sum will be contributed conditionally on the raising of a supplementary sum of 125,000*l.* by the University by December 31, 1910. The University, however, is endeavouring to raise 400,000*l.*, half for new buildings, while the other 200,000*l.* will be used for endowment. Among the extensions contemplated are a school of engineering, a department of preventive medicine, and a building for pathology. From the same source we learn that a joint hearing on the Bills to appropriate 130,000*l.* for new buildings for the College of Agriculture and 26,000*l.* for new buildings for the Veterinary College at Cornell University was given last month by the finance committee of the Senate and the ways and means committee of the assembly.

The seventh annual meeting of the central council of the Association for the Advancement of the Scientific Education of Indians was held in Calcutta on April 14. We learn from the *Pioneer Mail* that the resolutions were carried unanimously to the following effect:—That the Government be asked to fulfil its promise of starting graduate classes in mechanical and electrical engineering, mining and industrial chemistry, in connection with the Sibpur Engineering College at an early date; that Indian capitalists be appealed to to start industries and employ Indian experts in preference to foreign experts; that this council strongly urges upon the University and the Government to insist upon the training of the hand and eye of students attending schools; that Indian capitalists may, with every prospect of success, start the following industries, which have proved successful in Japan:—matches, pencils, porcelain, enamel, tobacco, sugar, hosiery, soap, perfumery, paper, glass, umbrellas, biscuits, leather, and printing-ink, industries for which experts trained by the association are available; that a syndicate be formed to raise 25 lakhs of rupees from the people of Bengal for starting industries to give employment to the large number of students who have been sent to foreign countries for industrial education.

In view of the fact that the Union Government will have to take over higher education shortly in Cape Colony, Prof. A. S. Kidd, of Rhodes University College, has prepared a brochure of forty-eight pages on the subject, and it is published by Messrs. Grocott and Sherry, of Grahamstown, at the price of one shilling. Prof. Kidd first explains the Higher Education Act of 1874, deals with the recommendations of the commission of 1879, and then describes the various colleges of the west and east of Cape Colony. His concluding section is concerned with the future of higher education in South Africa, and urges that one of the first duties of the Union Parliament should be to appoint a commission to inquire into and to report upon the whole subject. The chief work of the commission, Prof. Kidd thinks, should be the consideration of the following points:—which of the existing colleges deserve to be recognised as State colleges receiving generous support; what should be the constitution and functions of the various college councils; the special lines on which each college should be encouraged to develop; the salaries, good service pensions, and status of professors; the advisability of having some system of triennial inspection of college progress and efficiency; and the existing debts on colleges in Cape Colony, endowed chairs, bursaries, and scholarships.

As has been announced already in these columns, the third International Congress for School Hygiene is to be held in Paris from August 2 to August 7. The president of the congress is Dr. A. Mathieu, the honorary president being the French Minister of Public Instruction. The business of the congress will be transacted in ten sections, as follows:—educational buildings and furnishings, president, Prof. Courmont, of Lyons; hygiene of residential schools, president, M. Jules Gauthier, director of secondary education to the Minister of Public Instruction; medical inspection of schools and individual health records, president, M. Le Gendre; education and physical training, president, M. Cazalet; the prevention of contagious diseases in schools, president, Prof. Hutinel; out-of-school hygiene, president, M. E. Petit; the hygiene of the teaching staff, president, M. G. Lyon, rector of the University of Lille; teaching of hygiene, president, Prof. Pinard; teaching methods and syllabuses in relation to school hygiene, president, Prof. G. Lanson; and special schools for abnormal children, president, M. Gasquet, director of primary instruction to the Minister of Public Instruction. The general secretary of the congress is Dr. Dufestel, 10 Boulevard Magenta, Paris. Sir Lauder Brunton, Bart., F.R.S., is the president of the English organisation committee, and Dr. James Kerr and Mr. E. White Wallis are the honorary secretaries, to whom inquiries should be addressed at the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.

SOCIETIES AND ACADEMIES.

London.

Zoological Society, April 19.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—Stanley **Kemp**: Notes on the photophores of decapod Crustacea.—J. Lewis **Bonhote**: Variations of *Mus rattus*, founded on an

examination of the forms of that species found in Egypt. The author pointed out that on examination of the hind-foot measurements of a considerable number he found that the curve showed three distinct apices, and that two of these apices belonged, respectively, to the two forms found in Egypt, these forms being also more easily distinguished by their colour characteristics. The author in dealing with the rats of this species from the Oriental region had some years ago subdivided them into three subgroups, and it was now shown that the size of the feet typical of the three Oriental subgroups corresponded with the three apices in the curve of the Egyptian forms. He was inclined to think that these apices represented centres of variation, and were probably inherited as Mendelian characters, for were this not the case the smallest apex would have become swamped, and a regular curve would result. It was, however, evident that the small foot character was present and ready to become the dominant form in a very short time should conditions giving advantage to a small foot arise. On comparing the curve of the hind feet of *Mus norvegicus*, three apices were also observed, showing that in this species the "hind-foot character" was also present, but as there were no corresponding colour differences it was impossible to tell to which group any particular individual belonged. The author drew the following conclusion, viz. that there was considerable *prima facie* evidence that the size of the hind foot and the colour of the hairs on the underparts were Mendelian characters, and pointed out that the former character was also found in another species, *Mus norvegicus*, and the latter in a third species, *Mus musculus*. —G. E. **Bullen**: An example of posterior dichotomy in an Aylesbury duckling. A detailed account of a dissection performed on a duckling having supernumerary legs. In addition to a re-duplicated pelvis and the usual condition of the limbs presented in posterior dichotomy, it was found that the specimen showed evidence of a further re-duplication of the part dichotomised.

Royal Microscopical Society, April 20.—Mr. E. J. Spitta in the chair.—E. M. **Nelson**: What did our forefathers see in a microscope? The author dealt with the subject of what sort of image would be seen in a microscope of the highest type before 1825, about which date the achromatising of objectives was begun. After describing various old forms of microscope, particularly Dr. Robt. Smith's catadioptric microscope, the author gave examples with modern instruments.—E. M. **Nelson**: Critical microscopy. The author described the image of an object as being critical when it had been obtained by means of an objective of fine quality which had been placed in correct adjustment for that object, and when the illumination was critical. An object was said to be illuminated critically when it was placed at the apex of a solid axial cone, the aperture of which was not less than three-quarters of the N.A. of the objective.

Institution of Mining and Metallurgy, April 21.—Mr. Edgar Taylor, president, in the chair.—W. **McDermott**: The elements of slime concentration. In this paper the author gave a brief review of certain factors in the problem of slime concentration which seem to be established by practice, and then proceeded to draw conclusions from that review which would show the lines on which inventive and constructive development should proceed. He made a broad classification of the types of machine in use into five groups having different functions, and from that went on to analyse the conditions essential to efficiency, these being, respectively, time required for settling, smoothness of surface in final separation, speed of the washing water, and the special shaking motion necessary for settling and separation. Following these points was a consideration of the direction likely to be taken in future improvements, which may or may not provide for the production of a middle product, while the desirability or otherwise of classification under commercial conditions also received notice.—J. M. **Campbell**: The origin of laterite. The author dealt more especially with occurrences of laterite in West Africa, which he had observed and studied, though he sought to establish a similarity of origin for the Indian laterites, also in contradiction to the generally accepted theories of the Geological Survey of India. His definition was, briefly, to the effect that laterite is a porous rock, formed above low water-level in the strata on low-lying gentle slopes, by the gradual removal of some or most of the mineral constituents of either alluvium or rock *in situ*, and of the deposition therein of ferric and aluminous hydrates from mineralised water coming from below, the deposition being determined by contact with atmospheric oxygen.—J. M. **Campbell**: Native iron smelting in Haute Guinée (West Africa). This is a brief note compiled from observations of some native furnaces which are probably survivals of an ancient system of iron smelting, no record of which appears to exist. Their chief interest consists in the method of operation by natural draught only, induced by the introduction of clay tuyers, which convey air to the combustible matter, so dispensing with artificial blast. The note is of historical interest only, as the method of smelting is now almost extinct.—H. B. **Williams**: Hammer drills in overhand stoping and raising. In this paper the author gives particulars of the construction, operation, and work performed by a hammer drill operated by compressed air, which has been in practical use for some time in some gold mines in British Columbia, and has shown some distinct advantage over hand labour and ordinary piston drills in certain classes of work.

Challenger Society, April 27.—Dr. A. E. Shipley in the chair.—A. **Earland**: The Foraminifera collected by the fishery cruiser *Goldseeker*, with special reference to the survival of boreal species in a southern locality. These Foraminifera had been dredged in the area of the Moray Firth and North Sea to the east of Scotland as far north as the extremity of Shetland, and eastwards to about 150 miles from the Scottish coast. Off Buchan Ness large and typical specimens of *Polystomella arctica*, P. and J., were obtained. In the deep "gully" off Burghead, Moray Firth, *Botellina labyrinthica*, Brady, was found in abundance, and *Hippocrepina indivisa*, Parker, a truly Arctic type, was frequent. From these records, and from the gigantic size attained by many arenaceous types in the comparatively shallow water of the central North Sea, the author considered that the present rhizopod fauna of the North Sea was of Arctic origin, surviving from the comparatively recent geological times when the North Sea had no connection with the Atlantic in the south. The immigration of warm-water types by way of the north of Scotland was regarded as further proof of the correctness of the geological theory, and many instances of such rhizopod types occurring in the northern area of the Moray Firth, but nowhere south of it, were mentioned.

Geological Society, April 27.—Prof. W. W. Watts, F.R.S., president, in the chair.—R. G. **Carruthers**: The evolution of *Zaphrentis delanouei* in Lower Carboniferous times. The simple corals that belong to the gens of *Zaphrentis delanouei* are of common occurrence in the Lower Carboniferous rocks of Scotland. Their distribution is sporadic, but it is possible to collect over areas of which the stratigraphy is known. Many specimens have been got together from horizons scattered throughout the sequence. The ontogeny has been investigated by serial transverse sections. The evolutionary changes observed are confined to the disposition of the septa, which has influenced the shape of the cardinal fossula in a marked manner. *Zaphrentis delanouei* is typically a Tournaisian species, and it has a wide fossula, expanded inwardly. When the gens first appears in the Scottish rocks *Z. delanouei* is the predominant form, but is associated with a mutation in which the fossula is parallel-sided. In the higher limestones of Lawston Linn another mutation appears, which is regarded as a sport from the direct line. In the succeeding Lower Limestone group the gens undergoes further modification. Adults of the two Cementstone species are extremely rare, and the predominant form has a fossula which narrows rapidly to the inner end. In the still higher horizons of the Upper Limestone group the last-mentioned mutation becomes predominant, and persists up to the Millstone Grit, where the septa become more

amplexoid. All these mutations in neanic life have characters seen in adults of the preceding form. Mutational percentages are given for many localities in the Carboniferous Limestone series of the Central Valley, together with an analysis of the data so obtained.—A. **Wilmore**: The Carboniferous limestone south of the Craven Fault (Grassington-Hellifield district). Some of the beds are massive, coarsely stratified limestones, made up largely of crinoids, or corals, or shells; others are well bedded, almost flaggy, black limestones made up of comminuted matter, with abundant foraminifera. The strata are much disturbed everywhere. A series of folds strike roughly north-east and south-west, and are somewhat complex. The well-known knolls ("reef-knolls") are discussed. Their beds and those in the neighbourhood are much disturbed. Irregular coarse bedding, folding, and weathering will explain their structural peculiarities. A typical knoll is dissected, and it is seen to consist of folded, faulted, grey, coarsely bedded limestone, with great joints and much internal weathering. It is not easy to work out the exact zonal sequence, because of the disturbed character of the strata and the prevalence of glacial and fluvio-glacial drifts. The strata are apparently all Viséan (and probably there is nothing lower than Middle or Upper S). In some beds, and in some circumstances, fossils are exceedingly plentiful. Some corals receive special notice.

MANCHESTER.

Literary and Philosophical Society, April 5.—Mr. Francis Jones, president, in the chair.—R. L. **Taylor**: A preliminary note on the action of carbon dioxide and of air on bleaching powder and similar substances. Contrary to what is generally supposed, carbon dioxide, in presence of moisture, liberates no hypochlorous acid from bleaching powder, either solid or in solution, but only chlorine. Similarly, carbon dioxide liberates nothing but bromine from a mixture of a bromide and a hypobromite. When air, freed from carbon dioxide, is passed through a solution of bleaching powder, it slowly sweeps out hypochlorous acid, which is present in the free state in the solution, being produced by the action of water on the calcium hypochlorite. If, however, moist air containing the usual small amount of carbon dioxide is passed through bleaching powder, either solid or in solution, a mixture of chlorine and hypochlorous acid is given off, the chlorine usually largely predominating. In the case of the solid substance, after the moist air has been passed through for a considerable time, and the bleaching powder has thus become quite wet, there is no hypochlorous acid produced, but only free chlorine. When bleaching powder is heated with water and boric acid, practically pure hypochlorous acid is given off, no matter what proportion of boric acid is used. This forms a convenient method of preparing a solution of hypochlorous acid. Under similar conditions, a mixture of a bromide and a hypobromite evolves nothing but bromine.

April 20.—Mr. Francis Jones, president, in the chair.—G. P. **Varley**: The state of magnetisation of the iron boundary fence on the ridge between Black Sail Pass and the top of the Pillar Fell in the Lake District. The heavier iron uprights, which were firmly fixed in the rock, showed a north polarity below and south polarity above, while the floating uprights used for spacing the wires had, with few exceptions, the south pole below and the north above. The magnetisation of the heavy fixed bars was what one would expect from the action of the earth, but that of the floating uprights was not readily explicable.—Prof. S. J. **Hickson**: A new octoradiate coral. Some corals observed by Mr. Standen, of the Manchester Museum, in a bottom deposit obtained by Mr. Townsend at a depth of 156 fathoms in the Gulf of Oman (Persian Gulf) were submitted to the author for examination, and were found to belong to a genus that had not previously been described. It was therefore proposed to name them *Pyrophyllia inflata*, from the resemblance of the undulating septa to flames issuing from a cauldron. The zoological position of this coral could only be considered fully when its structure had been more carefully studied. All that could be said at present was that there were only two recent corals that seemed to approach it at all in the system of Zoantharia. These were *Guynia annulata*, Duncan, from the Adventure Bank in 92 fathoms of water, and *Haplophyllia paradoxa*, Pourtales, from off the coast of Florida in 324 fathoms of water.

EDINBURGH.

Royal Society, March 21.—Dr. R. H. Traquair, F.R.S., vice-president, in the chair.—Dr. J. R. **Milne**: A photometric "paddle-wheel." This apparatus has some resemblance to the well-known rotating sector, but possesses the advantage that the brightness of the light can be altered and the intensity recorded without the wheel being stopped. In its simplest form it consists of a disc fixed to the axle of a small electromagnet, and furnished with a number of vanes projecting beyond the edge of the disc, and set paddle-like with their planes parallel to the axis. When the axis of the disc is set parallel to the beam of light the vanes move in succession across the field edge on, and intercept very little light. If, while the wheel is rotating, the axis is inclined to the direction of the beam, the vanes will intercept a certain amount of light, depending upon the inclination of the axis to the beam. The paper contained graphical tables, from which the percentage of light transmitted can be found for various forms of vane and different angles of inclination of the axis. The position of the wheel can be recorded by a simple device, which in no way interferes with the rotation. The observer adjusts the rotating wheel until the intensity of the beam is brought to the right value, marks the position by means of a needle prick upon a strip of paper, and then proceeds to the next comparison without removing his eye from the eye-piece of the telescope.—Dr. J. R. **Milne**: A photometer on the flicker principle. The chief novelty of the instrument lies in a part consisting of a small telescope, in front of which two semi-circular glass wedges are rotated by an electric motor in such a way that there is made to fall alternately on the observer's eye first the light that has passed through the absorbing solution and then the light that has passed above it. The brightness of the latter beam is cut down by means of the photometric paddle-wheel described above until it is equal to the brightness of the former, this equality being shown by the absence of flicker.—D. P. **Macdonald**: A chemical investigation into the nature of the clay substance in the Glenboig fire-clay. The results obtained show that the clay substance contains 1·5 per cent. of water in excess of that required to satisfy the formula for kaolinite, and that the mineral is almost entirely decomposed by boiling in concentrated hydrochloric acid for thirteen hours.—W. A. **Caspari**: Contributions to the chemistry of submarine glauconite. Glauconite grains, when subjected to the action of acid, followed by that of alkali, disintegrate with formation of colloidal suspension of glauconite, whence pure amorphous glauconite may be coagulated. The pure glauconite prepared from grains found off Panama and the Cape of Good Hope answered to the formula $KFeSi_2O_6.H_2O$, where K_2O is largely replaced by MgO and FeO. Glauconite grains contain a small percentage of organic matter closely resembling alkali-soluble humus. This and other facts indicate that humus may well play a part in the formation of glauconite. Experiments on the absorption of water by glauconite show that it belongs in this respect to the same class as zeolites or colloidal silicates.

PARIS.

Academy of Sciences, May 2.—M. Émile Picard in the chair.—J. **Violle**: The fight against hail in the Beaujolais. The conclusion drawn by M. André in a recent note was to the effect that hail cannon serve no useful purpose. The author criticises the statistical methods of M. André, and states that during the six years 1901–6 the annual losses in the districts provided with hail cannon were only 0·24 of the average annual loss for the preceding twenty years. In the whole department the losses were 0·76 of the previous annual average.—C. **Guichard**: A mode of generation of triple orthogonal systems with spherical lines of curvature in a single system.—The perpetual secretary announced the death of Édouard van Beneden, correspondant for the section of anatomy and

zoology.—Ernest **Esclangon**: The changes in Halley's comet. On April 27 the most brilliant part of the nucleus was very close to a seventh-magnitude star in brightness, but the comet as a whole would appear to be of a higher magnitude to the naked eye. In the nebulous mass surrounding the nucleus there are two clearly marked surfaces of discontinuity, meeting at the nucleus at an acute angle.—J. **Haag**: Certain triple orthogonal systems. —P. E. **Gau**: The integration by the method of M. Darboux of the partial differential equations of the second order of the form $s=a(x, y, z)p+b(x, y, z)q+c(x, y, z)$.—A. **Chatelet**: The summation of continued arithmetical fractions.—Jean **Chazy**: The differential equations deduced from certain invariants of linear forms.—S. **Lattès**: The convergence of the relations of recurrence.—Léon **Lichtenstein**: The general definition of analytical functions.—André **Léauté**: Superintensities and supertensions due to the working of switches on the switchboard.—Eugène **Bloch**: The curves of saturation in the Hertz photo-electric effect.—M. **de Broglie**: The ionisation of gases by the actions of mechanical division of liquids: active and inactive bodies.—A. **Besson** and L. **Fournier**: The action of the silent discharge on chloroform and carbon tetrachloride in presence of hydrogen, and also upon methyl chloride. The products isolated from the first of these reactions include tetrachlorethylene, trichlorethylene, hexachlorethane, hexachlorpropylene, and higher boiling products. Methyl chloride (without hydrogen) gave a complex mixture which proved to be very difficult to separate by repeated fractional distillation.—G. **Dupont**: The isomerides of some acetylene γ-glycols. The glycols examined included

$$CCl_3.CH(OH).C\equiv C.CH(OH).CCl_3,$$
$$C_6H_5.CH(OH)—C\equiv C.CH(OH).C_6H_5,$$

and

$$(C_6H_5)(CH_3).C(OH).C\equiv C.C(OH)(C_6H_5)(CH_3),$$

two isomers of each glycol being described.—H. **Gault** and G. **Thirode**: The condensation of the secondary amines with γ-bromodimethylacetic ester.—J. F. **Thorpe** and G. **Blanc**: The product of the methylation of diacetoapocamphoric ester of M. G. Komppa. It is shown that the diketocamphoric ester of M. Komppa, one link in the synthesis of camphoric acid, has not the constitution assigned to it.—G. **Vavon**: The addition of hydrogen to essence of turpentine. The fractions from French, German, and American turpentine boiling under 165°, on treating with hydrogen in presence of platinum black, all gave a hydrocarbon with the same density, boiling, and melting points. Hence both α and β pinenes give the same hydride.—A. **Arnaud** and S. **Posternak**: The partial hydrogenation of the acids of the steorolic series and the isomerism of their addition compounds with hydriodic acid. —M. **Biéler-Chatelan**: The function of micas in arable soil.—H. **Sérégé**: An experimental study of the specific action of the Vichy springs employed in thermal therapeutics.—A. **Moutier**: The *rôle* of the arterial wall in the measurement for clinical purposes of the arterial pressure. —H. **Vallée** and L. **Guinard**: The physiological properties of extracts of the Koch bacillus, condensed and rendered sensitive. A study of the physiological properties of the precipitate obtained by adding serum from a horse which had been subjected to a special immunising treatment to culture solutions of the Koch bacillus.—Gabriel **Bertrand** and M. **Rosenblatt**: The temperature at which the plant tyrosinases lose their diastatic activity. The temperatures found varied between 60° and 95°, and these differences cannot be attributed to the nature of the solvent, but rather appear to be a specific property of the diastatic substances.—L. **Launoy**: Certain protoplasmic enclosures of the normal hepatic cell of the rabbit. The author describes under the name of pigmented lipoid bodies certain hitherto unnoticed corpuscles of complex structure in the hepatic cell of the adult rabbit.—Jean **Boussac**: The tectonic interpretation of the flysch of central and eastern Switzerland.—F. **Grandjean**: Remarks on the siphon of the ammonites and belemnites. The envelope of the siphon consists chiefly of calcium phosphate, and not calcium carbonate, as hitherto supposed.

CALCUTTA.

Asiatic Society of Bengal, April 6.—E. **Brunetti**: Review of our knowledge of the Oriental Diptera. The paper is a comparison between our present knowledge of the Oriental Diptera and that possessed by entomologists at the date of Van der Wulp's "Catalogue of South Asiatic Diptera" (1896).—Lieut.-Colonel D. C. **Phillott**: Vocabulary of technical and sporting terms in Urdu, Persian, and Arabic.—E. R. **Watson**, Monohar **Gupta**, and Satish Chandra **Ganguli**: A chemical examination of the butter-fat of the Indian buffalo.—E. W. **Vredenburg**: *Chondrodonta bosei*, a new species of fossil lamellibranch from the hippurite-bearing beds of Seistan. The first bivalve mollusc described in the Records of the Geological Survey, vol. xxxviii., part iii., proves to be a Chondrodonta, here named *Chondrodonta bosei*.—Hem Chandra **Das-Gupta**: Palæontological notes on the Gangamopteris beds of Khunmu (in Kashmir). On a visit to Khunmu, in Kashmir, remains of a palæoniscid and an ichthyod orulite fish were found, which are briefly described.—H. E. **Stapleton**: Contributions to the history and ethnology of north-eastern India, ii. This paper deals with the coinage of Assam in its relation to the history of Assam as given in the *Buranjis*. The chief materials on which it is based are:—(*a*) the find of nearly 1000 coins made in 1906 at the Daflating Tea Garden, near Jorhat, in Assam; (*b*) the cabinet of Assamese coins in the possession of Mr. A. W. Botham, C.S.; (*c*) the recent catalogue of Assamese coins in the British Museum, published in the *Numismatic Chronicle* by Mr. J. Allan; and (*d*) the writer's own collection of Assamese coins.

CONTENTS.

THURSDAY, MAY 19, 1910.

THE COMPARATIVE PHYSIOLOGY OF RESPONSE IN ANIMALS.

Umwelt und Innenwelt der Tiere. By Dr. J. von Uexküll. Pp. 259. (Berlin: J. Springer, 1909.) Price 7 marks.

THIS is one of the most interesting summaries of biological work that has appeared recently. Written by one who has had a large share in physiological research, it deals in an intimate manner with the comparative physiology of reflexes among the lower animals and with the adaptation of structure and function to varying habits in the case of allied genera. The influence of Sherrington's work is very obvious, and is suitably acknowledged, but whereas "the integrative action of the nervous system" is a profound study of the higher animals, the present work attempts the same analysis of action in various lower types, and then synthesises conduct in the light of the reactions so displayed. The anatomical knowledge required for this purpose is not great, and the technical physiological difficulties of terminology, though more formidable, are not insuperable. When these are acquired, the analytic skill of the writer in delineating the inwardness of animal movement becomes a source of real pleasure.

The main theme of the book is to discriminate (1) the effective external stimuli that constitute the "Umwelt" of each selected group or typical example; (2) the nervous stimuli set up within these creatures and forming the "Innenwelt," and (3) the sense of perception or "Gegenwelt" that arises in the "brain" of the higher groups. What part of its environment really affects an amœba, a sea-anemone, or a jelly-fish can only be determined by a study of its reactions, by an analysis of its neuro-muscular activities. Hence the need for a renewed analysis of muscular action and of nervous control. Accordingly, in each chapter the author, with a few vigorous sentences, sketches out the habits and movements of the type selected, and the dominant features of its muscular and nervous topography. A more detailed account of its reactions in relation to its mode of life is then given. Finally, the muscular action in relation to nervous stimulation is dealt with in detail, and the effective outer and inner world of the creature is summed up in a few lines.

The nature of protoplasm and the origin of structural organisation form the problems of the first chapter. "Does protoplasm possess a structure or is it a fluid?" is a question that has been varyingly answered for the last eighty years. Even if we agree with Bütschli and Rhumbler in assuming a certain structure in fluid protoplasm when at rest, the behaviour of "streaming" protoplasm (as in Amœba and cyclosis) forbids the assumption that any structure persists when the mass flows and points to its essentially fluid unorganised nature. Thus the first paradoxical property of this living substance becomes apparent, namely, its power of converting a fluid into an organ, into a series of organs, and then of withdrawing these and resuming its structureless condition. The Amœba or the digestive cell of a lowly worm "puts out" a highly organised process made from fluid unorganised protoplasm, and, having therewith enclosed some food, withdraws this appendage. The undifferentiated egg of animal or plant becomes organised, and the organisation may become resolved under adverse conditions into a structureless mass (as in the "brown-bodies" of Polyzoa), which is reorganised as more favourable conditions recur. This property of morphogenesis and regeneration separates living things from all machines, and when taken together with the phenomena of "regulation" (physiological changes in organisms consequent on stimulation), it shows, in the author's words, the supra-mechanical nature of the origin of structure, however mechanical the functions of organisation may be

The physical basis of life is indeed a paradox. Its organisation hinders rather than helps additional complexity, for that which is to constitute the addition has to be made, not out of what is already organised, but out of what has been left over of the unorganised protoplasm, and in this process not a present, but a future, mechanism determines the process. We think of action as the relation of precedent to consequent, but in protoplasmic action, what is consequent determines the initial stages of change. Animals and plants arise like a musical composition in which the later parts condition the earlier ones, even though they are only reached through the opening bars or movements. They are not like machines, unities in space only. They are also unities in time. In this sense von Baer's metaphor is magnificently expressive. Organisms arise, he says, like a kind of melody.

From this preface the author passes to a systematic treatment of invertebrates. On the basis of Jenning's researches, he concludes that Amœba (or at least *Amoeba terricola*) responds only to three kinds of stimuli—mechanical, chemical, and luminous. Paramecium, by a series of delicately poised adjustments, "rests more safely in its environment than a child in its cradle." It is so adjusted that all happenings bring it luck except the arrival of a carnivore of its own kind (Didimium). Far lower than these Protozoa in poverty of response is the ascidian Ciona. The effective environment of this creature during its active larval stage has not been analysed, but the adult sea-squirt is apparently dead to every impulse save one. Only mechanical shocks are recognised, and these in successional order. An interesting study of sea-anemones brings the writer to reflex-actions, of which these animals exhibit three—contraction of the circular muscles, secretion of slime, and contraction of the longitudinal muscles. The influence of tides and of light are certainly felt in littoral species, though in the case of the Mediterranean forms studied by the author their effect is apparently extremely slight. We feel, however, that the light-reactions will prove vastly more important than is here assumed, for the

simple reason, overlooked by von Uexküll, that these anemones are infected by symbiotic algæ.

The effect of wave-action is analysed in a most interesting section devoted to the higher medusæ. The simpler nature of the muscular reflex in Rhizostoma is first explained. It is shown how contraction of the circular muscles of the bell-margin, together with that of the stomach-wall, subserves at once locomotion, respiration, and nutrition. The food of Rhizostoma (Diatoms) is obtained by filtering the sea-water through the minute pores into which the oral aperture is converted. Especially attractive is the contrast in this section between the two allied genera, Rhizostoma and Gonionemus. The first leads a life of one stimulus. The rhythmical pulsation of its bell is its only act, its one stimulus. Gonionemus, on the other hand, though not structurally very diverse, leads a full life. It responds to light and to darkness, to gravity, to chemical and mechanical stimuli. The same world environs each animal: but an organism is, as it were, a wonder-world shut off from this environment, and only the right key opens it. When there is no lock there is no key, and such is the plight of Rhizostoma. Gonionemus has many doors, each with its special key.

From jelly-fish the author passes to the study of sea-urchins, and here he is thoroughly at home, leading the reader through a study of bionomics to an analysis of muscular contraction that is of the greatest importance to physiologists.

Of the author's analysis of the movements of the earthworms, leech, and Sipunculus we have no room to speak, but recommend it to the attention of all physiologically minded biologists; but a word must be said on Jordan's recent work on the locomotion of the mollusc, Aplysia. The body of this creature is enclosed in a muscular sac provided with a thick nerve-network. Each nerve is connected with this diffuse nervous system as well as with the ganglia. The extraordinary thing about the stimulation of this system is that, if the pedal ganglion be stimulated, the effect upon the network and muscular sac is entirely different from that proceeding from the cerebral ganglia. The "brain" inhibits motion; it acts as a brake. These animals, and possibly all Mollusca, resemble such machines as give rise to an excess of steam in all their parts, which excess is allowed to escape by numerous exits. The idea of a group of animals which acts in this way is an entirely novel one.

The further studies on crabs and dragon-flies are of great interest, and we wish it were possible to reproduce their conclusions. Enough, however, has been said to indicate the value of this work. If only the nature of the author's views on reflexes were expressed more clearly we should be inclined to place this book among the most attractive, as it certainly is one of the most illuminating, comparative studies that have appeared. It should appeal to the physiologist and psychologist as much as to the naturalist, and if translated (with a glossary appended) would be eagerly read by a much larger public than will appreciate it in its present form.

F. W. GAMBLE.

SCIENCE AND BELIEF.

Science and Religion in Contemporary Philosophy. By Prof. Émile Boutroux. Translated by Jonathan Nield. Pp. xi+400. (London: Duckworth and Co., 1909.) Price 8s. net.

THIS book is an able study of the various attempts which have been made since the beginning of the great scientific movement of the nineteenth century to comprehend science and religion in one system. The writers considered fall into two groups, according as they approach the problem from a naturalistic or spiritualistic standpoint. As representatives of the former M. Boutroux takes Comte, Spencer, Haeckel, the psychologists and the sociologists. The inclusion of Haeckel was perhaps due to his popularity; his dogmatism and inconsistencies are too crude to be worth the attention of an analyst so subtle as M. Boutroux. The discussion of the others might be said to be a discussion of three suggested unifying notions—the notion of humanity, that of the unknowable, and that of fact. The first M. Boutroux finds too narrow, for science refuses to accept an ideal from practical human need, and the essential object of religion is something that is more than man. The concept of Spencer gives liberty at the cost of significance; M. Boutroux shows very clearly that Spencer was led to it by a false standard of knowledge, the standard of pure objectivity, according to which to know the absolute would be to know it as one thing among others. As for the psychologists, who show that the scientific and the religious activities are amenable to common psychic laws, their reconciliation ignores the difficulty, which is the disparateness of the specific ideals inspiring these activities. The sociologists are in no better case; for the given social ends to which they propose to make religion and science both subservient are being by these continually recreated.

M. Boutroux's analysis of the spiritualistic efforts to solve the problem is equally searching. He deals first with the apologists. Some, like the Ritschilians, appeal to immediate internal conviction as the sufficient defence for religion; there are others who, by a criticism of science, show that it is ultimately founded on certain practical beliefs, and contend that science cannot object to religion merely as belief. But the first, since they have discarded all theory, can do nothing but indicate a mere subjectivity, and the second can offer only what appear to be arbitrary beliefs as against the verified hypotheses of science. Next is considered that philosophy which professes to find in activity a principle of unity deeper than the level of our intellectual contradictions, and regards science and religion as complementary but independent expressions of that unity. M. Boutroux points out here a dilemma; if the activity is indeterminate it is without meaning; if it is concrete it returns to us the problem with which we started. Finally, the hypothesis of James that religious experience belongs to the subconscious realm is discussed; the objection is made that the subconscious must be mediated by the conscious, and that hence its import will again be

conceived under the limitations of ordinary cognition.

The concluding chapter dwells on the relative and symbolic nature of science and its subordination to life; on the insufficiency of human life in itself as an end; on the ideal of duty which summons us beyond the specifically human to a noble struggle and a great hope, an ideal which implies faith and love, which demands a God, and a God with whom we can be in communion. It is in the "living reason" interpreted in the light of duty that science, without which we cannot live, and religion, without which we do not wish to live, find their reconciliation. It must be admitted that this chapter, fine as it is, could not endure the rigorous logic which M. Boutroux has applied to others. His duty is formal, and though a formal notion may, as he says, be efficacious, that concrete efficacy is psychological; we are no nearer a logical synthesis than we were, say, with the notion of concrete activity. But the failure of this effort at construction does not diminish the success of the book in its main intention of critical estimation. M. Boutroux is, like most French writers, a master in exposition; he excels especially in revealing that natural logic by which a biassed view tends to correct itself, an excellence which indicates both the generous critic and the trained philosopher. Probably no book has been written on the subject which will so well repay the student's attention.

THE CHEMISTRY OF THE SUGARS.

The Simple Carbohydrates and the Glucosides. By Dr. E. Frankland Armstrong. Pp. ix+112. (London: Longmans, Green and Co., 1910.) Price 3s. 6s. net.

CHEMISTS as well as physiologists will welcome the latest addition to the monographs on biochemistry, for there is no other branch of the subject which has afforded so many brilliant examples of successful synthesis or shed so much light on the intricate problems of enzyme action.

The editors have been fortunate in securing the collaboration of Dr. E. F. Armstrong, who has made a special study of the chemistry of the carbohydrates, and writes with an intimate practical knowledge of his theme. At the first glance through the pages of this volume one receives the impression that the author starts on too high a plane, and assumes an acquaintance with the methods and problems of stereochemistry which the biochemical reader may not possess; but one realises on reflection that if he has to compress into ninety-two pages the substance of a subject upon which volumes have been written, he has determined wisely in concentrating into this restricted space those modern developments of sugar chemistry which are of special interest to the biologist, and in leaving other things to take care of themselves.

It is, no doubt, for this reason that the main attention is directed to the natural sugars and glucosides, and that the artificial products are only touched upon where questions of a more general nature are concerned.

The first two chapters are devoted to the structure and properties of glucose, and are followed by one describing the natural hexoses and pentoses, whilst the fourth contains a description of the disaccharides. The succeeding two chapters contain an account of problems with which the author is more closely identified, and furnish much the most interesting reading. In the first of these the subject of configuration in its relation to enzyme action is discussed, and includes the selective action of maltase and emulsin on the glucosides to which Fischer first directed attention, and the selective oxidation of alcohols and sugars by the *sorbose bacterium* described by Bertrand.

Under "Hydrolysis and Synthesis," in which reference is made to the rate of hydrolysis of the disaccharides by acids and enzymes, the author discusses his stereochemical hypothesis, based on a series of interesting numerical data. Such a hypothesis, which may be tested experimentally, can only enlarge our outlook, and the same may be said of the mechanical similes of templates (p. 71) and glove fingers (p. 58), provided we regard the latter, as Fischer did his lock and key, as similes only and nothing more. The writer would, however, like to raise a mild protest against a fusion of the two ideas which the author makes use of in the formula on p. 58, where the atoms of enzyme and substrate are represented as interlocked, a theory which, on the one hand, can never be tested experimentally, and, on the other, can offer no advantage over the lock and key or other mechanical simile.

On the whole, the subject is well and clearly written, and there is very little with which the critical reader can find fault. Here and there certain passages occur which might be improved by expansion or modification, and in this connection reference may be made to the following paragraphs:—

On p. 66 we are told that the difference in the hydrolytic behaviour of enzymes and acids is "due mainly if not wholly (1) to the superior affinity of the enzymes for the carbohydrates; (2) to the very different behaviour of the two classes of hydrolysts toward water—which is a consequence of the colloid nature of the one and the crystalloid nature of the other." One would like to know more precisely how the "superior affinity" and "colloid nature" act in favour of the enzyme.

On p. 70 the author refers to Fenton's reduction of carbon dioxide to formaldehyde by magnesium as a deeply significant observation when considered in relation to Willstätter's discovery that chlorophyll contains magnesium. Are we to suppose that the magnesium in chlorophyll plays the part of the free metal? If not, what is the deep significance of the observation?

There is a slip on p. 59, where α-carbon atom should be "first carbon atom," and on p. 68, where it is stated that sorbose is derived from mannitol. Xylose is not limited to straw, but is found in most kinds of wood (p. 37). In the separate description of the disaccharides, for some reason not given, three members in table viii. are omitted. On the first page of the introduction the author says, "The members of the sugar group are usually distinguished by names hav-

ing the suffix *ose*." This being the case, it seems a little unfortunate that the termination "ide" for the generic names of the groups should have crept into our system of nomenclature. It is equally unfortunate that our present system recognises no means of distinguishing rotatory sense and configuration, and an official revision of both is urgently needed.

In conclusion, a word must be added in praise of the excellent bibliography at the end of the volume, the usefulness of which would be greatly enhanced if the references were numbered to correspond to those in the text. Under the present arrangement, reference to the source of information necessitates a reference to the chapter, then to a long list of names, and, finally, to the contents of a whole volume or series of volumes and original papers. J. B. C.

A PROSPECTOR'S HANDBOOK OF MINERALS.

The Recognition of Minerals. Being a Collection of Notes and Simple Tests for the Use of Travellers and Prospectors. By C. G. Moor. With Monographs on Geology, Ore Deposits, &c., by Donald A. MacAlister. Pp. vii+231. (London: The *Mining Journal,* n.d.) Price 7*s.* 6*d.* net.

THE old days of prospecting, when scanty equipment and slender knowledge, if backed by sufficient perseverance, were all that was requisite, have gone never to return. The insatiable demands of present-day life for purposes both of peace and war—may be for a filament for an electric lamp of improved efficiency, or a new alloy to impart exceptional hardness to steel—have enormously increased the range of mineral substances which a successful prospector must bring within his purview. In fact, it is necessary for him to have at hand more knowledge than can be conveniently or accurately assimilated by the memory, and he is compelled either to prepare for himself a series of notes or to put in his pocket a book such as that which Mr. Moor has prepared. Himself a traveller, Mr. Moor writes with the understanding of one who knows what exactly is the information required, and many of the sections, for instance, those dealing with the subjects of "panning" and "vanning," contain much detail of great practical value which may save the novice much time, trouble, and annoyance. To give that basis of theoretical knowledge which makes the radical difference between an intelligent understanding of the principles of the methods and merely blind rule-of-thumb working, several important monographs by Mr. MacAlister have been incorporated in the book. He has followed the customary treatment of the subjects, and discusses them in sufficient fulness for the purpose in view.

In the recognition of minerals, which, as the title tells us, forms the main subject of the book, reliance is placed upon the colour as an initial criterion. It is, as Mr. Moor points out, far from a constant character of most species, and, moreover, suffers from the disadvantage that the terms in which it is expressed are wanting in precision, and that the appreciation of delicate differences varies considerably with the individual. On the other hand, it is the most obvious of the physical characters, and suffices for a preliminary separation. The range is subsequently narrowed by the crystalline form, if any, and by determinations of the hardness and the specific gravity, until the identity of the mineral is established; the conclusion may be confirmed by the application of a few simple blowpipe and other chemical tests which are possible with a prospector's outfit. A full description of each mineral is given under the colour which most commonly characterises it, but cross-references are added under the less usual colours. The data that are given for each species include the hardness and the specific gravity, the ordinary chemical reactions, the localities where it has been found in workable quantity, and its commercial value. At the end of this section useful lists are added of minerals soluble in water, hydrochloric acid, and aqua regia, and of minerals which are unaffected by these liquids.

The section that follows on the metallic and non-metallic elements is particularly useful, because this information is not contained in a text-book on mineralogy. Under each element is given a list of the principal minerals in which it occurs, their physical and chemical characters, and particulars of its commercial use and value. Other sections deal with the important subjects of the working of the lodes and the extraction of the metal desired; a special section in the appendix is devoted to the extraction of gold. Mr. Moor mentions the precious stones, but gives few details, and refers the reader to two works the scope and nature of which he describes in the appendix. Of these one is quite satisfactory, though costly and too large for a traveller to carry about; but the other is full of mistakes in facts and principles, and is likely to prove a broken reed; it is strange that Mr. Moor should so strongly recommend it.

The book originally appeared in parts in the columns of the *Mining Journal,* and this fact may, perhaps, account for the eccentric pagination, the first page coming in the middle of the introduction, and for the division into sections and not into well separated chapters. The text is printed on the right-hand page only, the other being left blank, presumably for the addition of notes; interleaving would have been a neater and equally effective method. The index is fairly complete, but why should an irrelevant advertisement have been sandwiched between it and the text?

ELECTRIC DISCHARGES THROUGH GASES.

Conduction of Electricity through Gases and Radio-activity—a Text-book with Experiments. By Dr. R. K. McClung. Pp. xvi+245. (Philadelphia: P. Blakiston's Son and Co., 1909.) Price 1.50 dollars net.

THOSE teachers of physics who are considering the desirability and practicability of introducing into their more advanced courses of laboratory work some experiments on the discharge of electricity through gases and on the phenomena of radio-activity will find this book a useful guide. Believing that our

knowledge of the fundamental facts has now become sufficiently definite to justify the step, Dr. McClung has arranged a series of experiments designed to give a practical knowledge of the methods employed and the results obtained in these newer developments of electrical science. The description of the book as a text-book with experiments indicates the plan on which it is written. A connected account of the subjects considered is given from an experimental point of view, with descriptions and diagrams of suitable apparatus by means of which students may perform the experiments and test the results stated, without unnecessary complications. Thus the book provides a convenient summary of the results of recent researches, and is not a volume for the laboratory only.

The book is divided into two parts; chapters i.–vii. deal with electric discharges through gases, and chapters viii.–xvi. with radio-activity. In part i. accounts of kathode and Röntgen rays and a sketch of the ionisation theory are given, while descriptions of a few experiments on ionisation by ultra-violet light and by incandescent solids are added. We commend to the notice of those beginning research in this department the valuable chapter on the apparatus and instruments used in the investigations. The practical hints on the manipulation of electrometers and electroscopes, given by an experienced worker, cannot fail to be helpful. In part ii. experiments on the radiations and emanations from radio-active substances, on induced activity, and on the radio-activity of the atmosphere are described, and a sketch of the disintegration theory is added. A list of 125 experiments is given at the beginning of the book; the author suggests that the more difficult experiments, of which twenty are indicated, may be reserved by the student for a later stage.

We think that students contemplating research in these branches of physics would find the course a valuable preparation for their work. From the nature of the experiments, however, it will be evident that most of them could be undertaken profitably only by those who, as a result of their previous experience of practical work in electricity, have acquired considerable skill in manipulation; for it would be useless to set a student who was unable to manage a galvanometer to struggle with the difficulties of an electrometer. To set up the apparatus and perform the whole of the experiments would require a considerable time; but a student who worked through even a small number of experiments selected from the list would gain a valuable insight into the methods of investigation in use in this part of the subject. The provision, *for purposes of instruction*, of the apparatus which is necessary would, we fear, form a difficulty in some physical laboratories, and, paradoxical as it may seem, not least in those in which researches dealing with the subjects of the book are in full progress.

A few of the definitions in the theoretical sections require more careful statement, and the remarks on the law of decay at the end of chapter xii. need revision. The book is also capable of considerable improvement in literary style.

TWO BIOLOGICAL TREATISES.

(1) *Die Selektionstheorie.* Eine Untersuchung von August Weismann. Pp. vi+69. (Jena: Gustav Fischer, 1909.) Price 2 marks.

(2) *Experimentelle Studien zur Soma- und Geschlechts-Differenzierung.* Erster Beitrag. Von Prof. Johannes Meisenheimer. Pp. vii+149. (Jena: Gustav Fischer, 1909.) Price 6.50 marks.

(1) AMONG the most welcome effects of the Darwin commemoration held last year at Cambridge has been the reappearance of Prof. Weismann in the lists as a champion of the doctrine of natural selection, a cause which for the last fifty years he has never ceased to defend with the whole weight of his authority and learning. But for the invitation from Cambridge to contribute to the memorial volume published on that occasion, the veteran professor, as he informs us in the preface to his "Selektionstheorie," would scarcely have undertaken to add anything to his former writings on the subject. Now, however, he has not only enriched the Cambridge "Festschrift" with the English essay in which his views are so admirably stated, but he has published the same treatise in German, substantially unaltered, but with the addition of certain passages in which his conclusions on the subject of the reality of the selection-process are driven home with fresh force and cogency.

In this production Weismann's dialectical ability and literary skill shine out as conspicuously as ever; and it would be difficult to find, within the same compass, an equally convincing presentment of the case for Darwin's conception of the action of natural selection in the formation of species, or one more aptly illustrated by examples drawn from many departments of organic nature. While so much continues to be written which tends to overcloud and confuse the simplicity of the Darwinian position, it is refreshing to see how Weismann goes straight to the point, brushing aside those objections that proceed from imperfect appreciation of the facts to be explained, and quietly putting in their proper place, as subordinate to the selection-theory, certain well-attested phenomena which have in some quarters been supposed to be hostile to Darwinian interpretations. All this is done with the utmost candour and courtesy, and without the least trace of arrogance or contempt for adverse opinion. In full agreement with both Darwin and Wallace, Weismann here holds, as he has always done, that adaptation is a universal principle in the world of life, and that of this principle selection affords the one and only possible explanation. After reading the masterly defence of the position to be found on pp. 48–69 of the present treatise, those younger biologists who may have allowed themselves to be troubled with doubts as to whether, after all, the theory of adaptation by selection has not been overdone may well take fresh courage and renew their confidence in Darwin's solution of the teleological problem.

Sexual selection, to which Darwin attached much importance, has been vigorously attacked from many

quarters. Some of the staunchest upholders of natural selection, including Wallace himself, look askance at the theory which seeks to explain certain features of colouring and other ornamentation in male animals as the result of female preference. Here also Weismann ranges himself unhesitatingly on the side of Darwin. Sexual selection is to him a real and active transforming force, as demonstrable as natural selection itself, and passing into the latter by an easy transition. A specially interesting section of the present essay deals with the scent-producing organs of male Lepidoptera, the perfume distributed from which is now known in very many cases to be as agreeable to the human perception as it presumably is to that of its possessors or their mates. Weismann's own ancillary theory of germinal selection, suggested to some extent by Roux's conception of the "struggle of parts," is here lucidly expounded. Whether the theory be accepted or not—and many, it must be admitted, have found it unconvincing—there is no doubt that it would account for many facts at present not easy of explanation.

(2) The second treatise is of a different character. It contains a detailed account of elaborate experiments on the removal and transplantation of the primary sexual organs in the larva of *Lymantria dispar*, commonly known as the "gipsy-moth." Meisenheimer has succeeded, by the help of the galvanic cautery, in destroying the reproductive glands in larvæ of both sexes at various periods of growth, beginning with the earliest stage after emergence from the egg. In partly-grown larvæ he has been able to transplant the male primary reproductive organs into the body of a female, and *vice versa*. As principal results of his experiments he considers himself to have proved the inability of the reproductive organs, as distinct from mere sex-characters, for regeneration; and also the absence of any formative stimulus for secondary sex-characters, emanating from the primary sex-organs themselves. A transplanted ovary is shown to have no impeding effect on the development of the male reproductive apparatus, while the ovary itself can reach its fully mature condition when artificially inserted into the body of the male. The regeneration of sex-characters, where this takes place, is entirely unaffected by the absence of the primary sex-organs of the individual concerned, or by the presence of those of the opposite sex. The conditions obtaining in hermaphrodites naturally occurring among the Articulata are similarly adverse to the theory of a special formative stimulus for the secondary sexual characters. Meisenheimer is, of course, well aware that the experimental evidence derived from vertebrates seems, *prima facie*, completely at variance with his own results; but he adduces much ingenious argument with the purpose of showing that the "internal secretion" of the testis and ovary, which is certainly a reality, has nevertheless no such specific influence on sex-characters, whether somatic or psychic, as has been supposed. It is, according to him, entirely a matter of enhanced or impeded exchange of material (Stoffwechsel). Metabolism is partially checked by castration, and can be restored by the artificial reintroduction of generative products, not necessarily of the same species. But this metabolism is not specially concerned with the sex-apparatus or secondary characters, and any effect it may have thereon is incidental and not essential. The author's facts are undoubtedly striking, and his criticisms of adverse views are weighty. But his argument as regards vertebrates is not entirely convincing.

F. A. D.

OUR BOOK SHELF.

Metalography (Printing from Metals). Being a full consideration of the Nature and Properties of Zinc and Aluminium, and their Treatment as Planographic Printing Surfaces. By Charles Harrap. Pp. xvi+170. (Leicester: Raithby, Lawrence and Co., Ltd. 1909.) Price 3*s*. net.

THIS treatise professes to be a text-book on the subject of printing from metal plates instead of stone, and is addressed to the lithographic trade. The term "metalography" is a word invented to specify this particular form of printing as distinct from "metallography" as used by metallurgists in a general sense.

Although metal has been in use with more or less success during the past century, it is evident that it is fast coming into more general demand. Zinc was first used, and is still used very largely, but aluminium has more recently been employed as the basis for taking or holding the design to be printed from. The readiness to which either metal lends itself in bending or curving has in turn suggested the manufacture of printing machines of a rotary character, and the result is that there has been a remarkable development in the presses used in producing printed work by the lithographic method.

For some classes of work the stone is still preferred, and probably better results can be obtained from this material in some instances; but if the question of first cost of stone as compared with metal plates is to be studied, the latter are the more economical. Again, the question of space occupied and the great weight of stones for both storage and carriage must be considered. As already indicated, the introduction of metal plates has allowed more scope for the machine-builder, which has quickened and cheapened the output. With the ordinary lithographic stones, which must be printed from the "flat," it was hardly possible that the old forms of presses could be much improved upon.

One other important development has been the introduction of the rotary off-set presses by several manufacturers, which may be used in connection with one or more colours in printing. Either zinc or aluminium plates may be used, and these are fastened round a cylinder, which gives its impression or off-set to another cylinder fitted with a rubber sheet or blanket. The paper to be printed is then conveyed by grippers to a third cylinder, which in motion receives its impression from that which is covered by the rubber.

Very good results are given on cards, or even rough paper, without previous dampening of either material; this obviates the employment of glazed or calendered surfaces, which is a decided advantage. The finished sheets are delivered automatically and the printed face upwards, so that the work can be easily watched in course of production. Such machines as these will produce 1500 or more copies per hour, fed in singly by hand, but the output may be considerably increased by adopting an automatic feeder.

The author has treated the whole subject in a very practical manner, and his long experience as a

technical teacher enables him to put the book into a succinct form, suitable alike for the worker and for the student. The volume is also to be recommended to the general seeker after knowledge of the printing arts.

Modern Telephotography; a Practical Manual of Working Methods and Application. By Captain Owen Wheeler. Pp. 80. (London: Ross, Ltd., 1910.) Price, paper, 1*s*. 6*d*.; bevelled boards, 2*s*. 6*d*.

CAPTAIN OWEN WHEELER is an enthusiastic and successful user of telephotographic lenses, and in this small volume he sets down his experiences in plain language, and gives the rules that he has found serviceable. He refers only to the lenses issued by the publishers, but this is the only drawback to an eminently practical and useful treatise. Seeing that the one advantage of a telephotographic lens is that it gives the image on a larger scale, without the need for an equivalent length of camera, and that it is as applicable to near, as to distant objects, the photography of near objects is very meagrely dealt with. But this is rather an advantage than otherwise, as it indicates that the author treats only with those matters of which he has had considerable experience.

The two details that the author's name is chiefly associated with are the use of a hood in front of the lens to cut off extraneous light, and the use of negative lenses of different powers for different magnifications, instead of trusting to variations in the length of the camera. It is hardly too much to say that, trivial as these details appear, Captain Owen Wheeler has by means of them revolutionised the practice of outdoor telephotography. He truly claims that his photographs bear no sign of their special method of production, the flatness and fog so often present being completely obviated. The long hood that he first caused to be available had a rectangular opening in front, and was of liberal dimensions—here he seems to refer only to telescoping tubes little, if any, larger than the outside of the lens mount. If this is so, it is distinctly a step backwards in efficiency, though the aluminium tubes may be more appreciated by the manufacturing optician. Concerning the choice of lenses, with an ordinary half-plate camera and a lens of about seven inches focal length, and a camera extension of fourteen inches, the author advises negative lenses from about $2\frac{1}{2}$-inches to 1-inch focal length, the last giving an equivalent focal length of about 8 feet, or a magnification of about fourteen diameters. The aperture of such a combination obviously must be small, but he does not find diffraction to interfere vitally with definition, even at an aperture of f/480. There are many excellent illustrations in the book, and a final chapter on telephotography as applied to the special requirements of the army and navy.

C. J.

A Text-Book of Nervous Diseases. By Dr. W. Aldren-Turner and T. Grainger Stewart. Pp. xvii+607. (London: J. and A. Churchill, 1910.) Price 18*s*. net.

THIS book has been written for the purpose of providing the practitioner and senior student with a short and practical account of the diseases of the nervous system, and is not expected to take the place of the larger works on the same branch of medicine. Owing to the limitation placed upon the size of the book, the description of certain disorders, such as myxœdema and acromegaly, usually contained in works of this description, has been omitted. This we cannot but regard as an advantage, for there seems no scientific reason why diseases of ductless glands should be catalogued with diseases of the nervous system.

It is of the utmost importance, in dealing with organic nervous affections, that the student should possess an efficient knowledge of anatomy, and be acquainted with some methodical plan for the clinical examination of the nervous system. We are happy to find in this work a short but clear and satisfactory description of the various tests which are available to inform us as to whether a given system is normal or not. There is no obfuscating mass of detail from which the student has by long experience to abstract the useful and eliminate the comparatively unimportant, but a clear, succinct presentment of all that is really essential. The anatomical chapters are similarly well rendered. The book, so far as organic nervous disorder is concerned, is singularly replete, and we can think of no recognised affection which has escaped adequate attention. Considering the relative proportion of the incidence of organic and of the so-called functional disorders, we cannot but regard it as rather a pity that more space has not been devoted to the symptoms, diagnosis, and treatment of the latter class. Herein, however, the authors are only following the trend of British neurology, which has always been rather in the direction of the study of organic disease. In these days, when such an enormous amount of work is being done by non-scientific bodies in the treatment of functional maladies, it becomes very necessary for the trained physician, with his infinitely superior opportunities, to make himself familiar with therapeutic measures suitable for such ailments. Only in this way can unfortunate sufferers be saved from those errors of diagnosis which untrained and self-constituted professors of certain modes of therapeutics are frequently making, and which are so often of fatal consequence. The illustrations and diagrams with which the book is garnished are admirable, and are most helpful in illuminating the text. The work cannot, we think, fail to be of assistance to those for whom it is intended, that is, to the student and practitioner.

Australasian Medical Congress. Transactions of the Eighth Session held in Melbourne, Victoria, October, 1908. Vols. i., ii., iii. (Victoria: J. Kemp, Melbourne, 1909.)

THESE three volumes of transactions are sure evidence, if that were needed, of the activity of our kinsfolk over the sea in matters medical. It is quite impossible in a short space to deal with their subject-matter, which embraces the whole range of medicine, surgery and gynæcology, anatomy and physiology, pathology, bacteriology and public health.

Dr. Julian Smith discusses the opsonic test and its applications to tuberculosis. He considers that in competent hands opsonic determinations are trustworthy and accurate, and in many cases invaluable as an aid in diagnosis and a guide to therapeutic measures. Various papers deal with tuberculin and sanatorium treatment in tuberculosis. Prof. Welsh, Dr. Chapman, and Mr. Storey discuss some applications of the precipitin reaction in the diagnosis of hydatid disease. It was found by Welsh and Chapman that the blood serum of a patient suffering from hydatid disease, which is relatively common in Australia, gives a precipitate with the fluid of the hydatid cyst. In the present paper the extension of the test by the use of old hydatid fluids is discussed. Hæmogregarine parasites in a marsupial flying squirrel and in the native cat are described by Drs. Welsh, Barling, Dalyell, and Burfitt, and Dr. Elkington describes a new cestode worm (*Dibothriocephalus parvus*) obtained from a Syrian patient. The volumes are well printed, and illustrated with many excellent plates.

Atlas of Japanese Vegetation. With explanatory text. Edited by Prof. M. Miyoshi. Set xiii., plates 86–92, pp. 6: *Coast Vegetation of Middle Japan.* Set xiv., plates 93–101, pp. 7: *Mountain Vegetation of Northern Japan.* (Tokyo: L. P. Maruya and Co., Ltd.; London: W. Wesley and Son. 1909.)

The series of botanical plates illustrating Japanese vegetation, of which the two sets under notice are late numbers, are phototype reproductions illustrating plant-landscapes and a few cultivated plants, arranged for the most part topographically. The thirteenth set contains photographs of a temperate region, in which *Pinus Thunbergii* is a typical tree along the coast. It is shown with a foreground in one case of *Rosa rugosa,* and in another of *Calystegia soldanella.* Another photograph represents a broad expanse of the Calystegia, and two plates show a curious segregation of male and female plants of *Carex macrocephala.* The nine plates forming the fourteenth set are taken from three different mountains. Two photographs taken on Mount Azuma depict *Rhododendron Albrechtii* and a natural double-flowered variety of *Rhododendron brachycarpum.* The scenes from Mount Iide include a fine spread of *Phyllodoce aleutica* interspersed with *Geum dryadoides,* and an association of *Geranium davuricum* with *Adenophora polymorpha.* Mount Iwate is the station which provides an unexpected combination of *Rhododendron kamtschaticum* and *Pinguicula vulgaris.* The illustrations, measuring about nine inches by six inches, are remarkably sharp and well defined, and are highly creditable to Prof. M. Miyoshi and Mr. G. Nakhara, who are responsible for the original negatives.

Actualités scientifiques. By Max de Nansouty. Pp. 380. (Paris: Schleicher Frères, 1909.) Price 3.50 francs.

This interesting "annual" of M. Max de Nansouty, the sixth to appear, will be welcomed by the general reader anxious to acquaint himself, in as pleasant a manner as possible, with the more popular of the recent advances in science. It is natural in this issue to see great prominence given to the problems in connection with aviation and to electricity in its applications, but readers will find that most branches of science have been drawn upon to produce an interesting miscellany. The volume may be recommended specially to students of science anxious to keep up their French without neglecting their own special work unduly.

Mathematical Tables: with Full Tables of Mathematical and General Constants. By R. W. M. Gibbs and G. E. Richards. Pp. 17. (London: Christophers, n.d.) Price 8*d.* net.

These conveniently arranged tables provide all that pupils in ordinary secondary schools and technical classes require in their mathematical and science lessons. They include logarithms and antilogarithms, natural and logarithmic sines and cosines, tangents and cotangents, and tables of formulæ and data.

Weighing and Measuring. A Short Course of Practical Exercises in Elementary Mathematics and Physics. By W. J. Dobbs. Pp. ix + 176. (London: Methuen and Co., 1910.) Price 2*s.*

Though there is little that is new either in the method or contents of this book, teachers will find here a clear, well-arranged set of practical lessons on the measurement of length, area, volume, mass, and density. An abundant provision of questions—original and otherwise—has been made, especially for candidates in the Army Qualifying Examination.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

A Sponge with a Siliceous and Calcareous Skeleton.

In Willey's "Zoological Results," part iv., 1900, J. J. Lister described certain small columnar coral-like organisms from 35–100 fathoms off Lifu and Funafuti as calcareous sponges. He named them *Astrosclera willeyana,* and, on account of their isolated position, placed them in a new family—Astroscleridæ. The skeleton was formed of minute calcareous spherules, separate above, but welded below into solid walls and blocks, the spherules being formed each in a single cell.

Recently Dr. C. W. Andrews obtained from 46 fathoms off Christmas Island four more specimens of this sponge. A decalcified section showed that Astrosclera was probably a siliceous Ectyonine sponge, for its canal walls were bristling with spiny nail-shaped siliceous spicules (Fig. 2). I concluded that this siliceous sponge had formed a supplementary calcareous skeleton from foreign particles which had been picked up from outside, so extremely improbable did it seem that a sponge could secrete both lime and silex. Later preparations, however, have shown

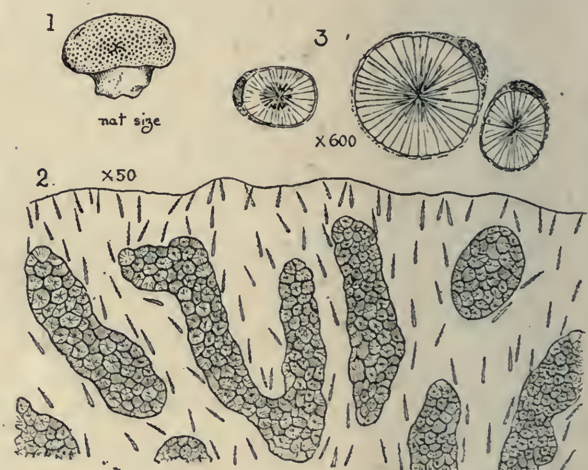


Fig. 1.—A specimen of *Astrosclera willeyana,* Lister. Natural size.
Fig. 2.—Section showing laminæ and masses of calcareous spherules, and nail-shaped siliceous spicules. ×50.
Fig. 3.—Nucleated cells containing calcareous spherules. ×600.

me that Lister was right, and that each spherule (apparently of conchite) is formed in a single cell (Fig. 3).

Fig. 1 is that of a living specimen and not of a dead stock, and yet I can find no trace of anything else than sponge tissue and spherule cells. Further, the superficial stellate grooves which are excavated in the calcareous mass are formed by the terminal exhalant canals of a sponge.

I continue to regard Astrosclera as a siliceous sponge, though I have just become aware that an eminent German zoologist has a very different opinion concerning its nature. Assuming that my theory is correct, Astrosclera may possibly owe its unique character to an ancestral habit of picking up foreign particles—in this case—of calcareous detritus, for the sponge has only been found on coral reefs. Some of the lime would dissolve and become re-crystallised in the connective tissue cells. When once this character had been acquired, the clumsy method of the sponge choking itself up with débris would be replaced by the more "scientific" process of elaborating lime direct from the sea water. I hope soon to set forth in detail the *pros* and *cons.* of this theory.

R. Kirkpatrick.

British Museum (Natural History), South Kensington.

A Difference in the Photoelectric Effect caused by Incident and Divergent Light.

IN a letter dated April 26 which appeared in NATURE of May 12, Mr. Stuhlmann, of Princeton University, U.S.A., describes some experiments which he has carried out on the photoelectric effect of incident and emergent light. I should like to mention that I have been carrying out some experiments on the same subject at the Cavendish Laboratory, Cambridge, and obtained the same effect as that described quite recently by Mr. Stuhlmann. The experiments were completed more than two months ago, and the results obtained described in a paper communicated by Sir J. J. Thomson to the Royal Society on March 25. In view of the appearance of the above letter they may be briefly described here.

A thin quartz plate was covered with a very thin film of platinum in a discharge tube by directing the discharge from a platinum kathode on to it. The kathode radiation per unit time from the film under the influence of ultra-violet light was measured (1) when a constant beam of ultra-violet light was incident at right angles to the film; (2) when the beam emerged from the film, passing in this case first through the quartz plate. The intensities of the kathode radiations were found to be as 1 to 1·16, while the intensities of the incident and emergent beams were as 1 to 0·5. The conclusion that can be drawn from the experiments is that an electron liberated by ultra-violet light has a component of motion in the direction of propagation of the exciting light.

Cambridge, May 14. R. D. KLEEMAN.

Steam Tables.

IN NATURE of April 21 a review appeared of Profs. Marks and Davis's excellent new tables of steam properties, in which it is stated, without qualification, that the new calculations of the total heat of saturated steam are based upon a second-degree equation $H = a + bt + ct^2$. Both in the explanatory notes to the tables, and still more emphatically and repeatedly in a paper printed in the Proc. Am. Acad. Arts and Sciences, March, 1910, the authors state that this equation does not apply outside the limits 200°–400° F. Simple numerical tests also prove that the tabular figures do not agree with this formula outside these limits, and the formula would give H its maximum value at 72½° F. higher temperature, and four heat units more in quantity, than the tables make it. Mr. Davis says that no formula yet discovered will apply throughout the full range, and above about 450° F. the figures given are not credited with a high degree of accuracy or certainty.

Basing upon these new tables, I constructed a formula for total heat, which was published on December 24, 1909, in the *Engineer*, and gives the tabular results with practical exactitude from 70° to 500° F., that is, from 0·36 to 684 lb. per sq. inch absolute pressure. This formula is

$$H = 1826 + t - 10^7 \div 8(1620 - t).$$

The following are its "errors" as compared with Marks and Davis's tables:—

$t°$ F.	30	50	60	70	80	100	150	200
H Diff.	−2·7	−1·6	−1·2	−0·7	−0·5	0	+0·4	−0·1

$t°$ F.	250	300	350	400	450	500	600
H Diff.	−0·2	−0·1	+0·3	+0·1	−0·4	+0·9	+24·9

The order of accuracy aimed at in this formula is further illustrated by the factors 0·9938, 0·997, 1·0066, and 1·055 having been tried for the term in t instead of 1, and having failed; while, in place of $10^7 \div 8 = 1,250,000$, one of the factors which was tried and failed was 1,251,150.

The maximum value of H given by this formula is 1210, which is identical with that of the tables, but it occurs at 502° instead of 480°. Exactitude in placing this temperature of maximum H by the purely graphic analysis of a very few experimental results in its neighbourhood which was used by Marks and Davis, is evidently impossible. The tables do not venture to give any values of H above 600° F. My formula may very likely give considerable errors near the "critical point," which is somewhere near 690° F. Here other physical influences probably become prominent, as also, very probably, at low temperatures near that of maximum water density. ROBERT H. SMITH.

3 Thirlmere Road, Streatham, S.W., May 2.

I NOTICED at the time of its publication in the *Engineer* Prof. Smith's communication of the discovery of an empirical formula which would represent the values of the total heat even more accurately than that of Messrs. Marks and Davis. When speaking of their own formula the authors remarked (pp. 100–1):—"It has been used for the range above 212 in these tables"; but they evidently meant to limit the range to 400° F., although this is not clearly expressed in the paragraph from which the above extract is taken.

I agree with Prof. Smith that it is too much to expect any empirical formula to predict what will occur at the "critical point." THE REVIEWER.

Fireball in Sunshine.

ON May 10, at 7h. 52m. a.m., a magnificent meteor was seen by many observers in the Midlands. I have read a considerable number of descriptions of the object, but they are not very definite. The meteor was witnessed by persons not well versed in astronomy and exact positions for the apparent flight. It was a brilliant object with a bluish nucleus and tail of red sparks; the observed velocity was moderate. Though the sun was shining the meteor shone with conspicuous effect, and more than one person supposed it to be Halley's comet, or, at any rate, a fragment of that body.

Seen from Birmingham, the meteor's path was from the north-east to north-west, and one good observation ascribes to it an altitude of 30 degrees in a perfectly horizontal course. It is difficult to assign the real path, but an approximate computation places the height at from about 83 to 32 miles along a luminous trajectory of nearly 100 miles at a velocity of 20 miles per second. The position of the radiant point is doubtful, but several of the observations indicate it in Auriga or Perseus. The meteor travelled over the region of Yorkshire or Lincolnshire towards the district of Liverpool, but in the absence of more exact materials it is quite impossible to derive the path with certainty.

No stars being visible in the bright blue of the May morning which presented this unusual celestial phenomenon, the observers could not locate the position with the required accuracy; but it is hoped that further observations will come in from the northern counties of England. The "daylight fireball" of May 10 last reminds us of a similarly brilliant object which flashed out amid the sunshine on October 6 last at 9.40 a.m. W. F. DENNING.

Observations of Halley's Comet and Venus.

IT may interest readers of NATURE to know that the planet Venus was visible—plainly visible—in Natal all day to-day up to the time of its setting. The air was wonderfully clear and free from dust or moisture. At four o'clock in the morning Venus was unusually brilliant, the light therefrom shining into my bedroom. Halley's comet rose above the horizon at about 4.30, and, although distinctly visible to the naked eye, was pale and insignificant compared to the planet. By six o'clock the comet was no longer visible, having paled away before the sun had actually risen. At mid-day excited groups of natives and Europeans were gazing with wonder at what was mistakenly considered to be Halley's comet visible in broad daylight! Venus was then in the zenith, her glory defying the power of the mid-day sun. E. T. MULLENS.

Pietermaritzburg, Natal, April 22.

Earwigs of India.

IN NATURE of April 14 was published a review of my half-volume on the Dermaptera in the "Fauna of British India" series, in which the reviewer directed attention to a most regrettable oversight on my part in omitting to allude to the British Museum when acknowledging the various sources which supplied me with material.

Fortunately, the frequent references in the text betray my indebtedness, but I should be glad to take advantage of the hospitality of your pages to make amends, at the same time thanking your reviewer for pointing out this extraordinary omission, by expressing now my appreciation of the invariable and well-known courtesy of my good friends among the officials of the museum.

Eastry, Kent, May 5. MALCOLM BURR.

THE TOTAL SOLAR ECLIPSE OF MAY 9, 1910.

IT was reported in last week's NATURE that, owing to very unfavourable weather conditions, the eclipse of the sun, visible from Tasmania, could not be observed at all. In spite of the fact that the weather conditions in that month were not considered to be very favourable, the parties that set out from England and Australia did not expect to have to contend with the very abnormal weather that they actually experienced. Indeed, the southern part of Australia has, according to recent mails, been suffering also from weather frolics, so that these exceptional conditions were not limited to the eclipse stations.

Those who have been out on eclipse expeditions can quite understand the amount of work involved in the erection and adjustment of several high-powered instruments. Under such conditions as "only two fine days in the last fortnight; terrific gales and thunder frequent," as Mr. Frank K. McClean reports from his station, an idea will be gathered of the difficulties under which he and his party had to labour.

Although the results of the eclipse are negative, it is nevertheless of interest to place on record the elaborate instrumental equipment which Mr. McClean took out with him to use. They consisted in the main of two spectrographs for obtaining photographs of the spectra of the chromosphere and corona, and three coronagraphs of different powers for securing records of the form of the corona. In connection with these instruments he took with him a large 21-inch siderostat and a 16-inch coelostat, to feed the above instruments with light from the eclipsed sun. In addition to these, he had several instruments of minor importance. With such a fine equipment and such willing helpers it is a pity that it was not possible to make an attack on the eclipsed sun.

It will be remembered that the eclipse track traversed the southern part of Tasmania. As the Australian party occupied Bruni Island, Mr. McClean, in order to obviate any local bad weather condition, set himself the task of selecting another site. This scattering of eclipse parties along the path of the moon's shadow on the earth is usually done when possible; but sometimes, as in this case, very considerable extra labour and difficulties are met with, as it necessitates the additional equipment of the expedition with all the requirements for camp, food, extra help, &c. Such impediments were not likely to deter Mr. McClean from roughing it in some lonely spot away from all civilisation. In order to give the reader some idea of the trouble he took in selecting a site and some details of the spot he finally determined upon, the following communication I have received from him will serve this purpose. I may, however, preface this account by stating the names of the members, up to the date of his letter, which formed his party:—F. K. McClean, England; Joseph Brooks, Sydney; J. Worthington, England; H. Winkelmann, Auckland; Allan Young, England; S. G. Dowsett, Auckland; and Ernest Jeffs (steward), Auckland; Arthur Wilson (assistant steward and carpenter), Hobart.

April 4, 1910.

On arriving at Hobart on March 24 I found that Mr. Brooks and Mr. Worthington had already obtained much information about the possible localities for the Eclipse Camp. Mr. Worthington had also examined the east coast to the south of Hobart, and from him I learnt that there was no really good site to be obtained. Later we three made a short excursion south, and found that the whole of the country was mountainous and covered with bush, while, except for the road, which never went far from the sea, there was no possible means of communication. At Dover, on Port Esperance, there was a gap running through these mountains, and from Hope Island in the harbour a fair view could be obtained, giving for some 20° in azimuth a horizon not rising more than 3° above the horizontal. This was a possible place, but owing to the presence of Adamson Peak, 4000 feet high, in the field of view, there was a great probability of clouds even with the rest of the sky clear. We did not visit Bruni Island as the Australian expedition had chosen their site there, and also because the altitude of the sun was only $6\frac{1}{2}°$ at eclipse. Having found that the east coast offered no reasonable site for observation, the south-west coast was next visited. To do this it was necessary to take the train to Launceston and Burnie on the north coast, and the following day travel by Zeehan to Strahan, also by rail. Mr. Hughes, the manager of the Union Steamship Co.

FIG. 1.

at Hobart, had communicated through to arrange for their steamer, the *Wainui*, to call in at Port Davey after leaving Strahan on its way to Hobart, and we were met by Mr. Eva, the local manager of the company, who did everything possible to assist in the arrangement. Accordingly, on the next day we started on the *Wainui* under Captain Livingstone, and early the following morning found ourselves in Port Davey, and were on shore before sunrise.

We first ascended the hills south of Bathurst Channel to get a general view of the country. In every direction rose hills and mountains from 600 feet to 2000 feet high, and between them were stretches of land-locked water leading out into Port Davey proper and the Southern Ocean. Some of the mountains were masses of almost bare rock, while others looked as though covered with smooth grass, which, however, when traversed, were found to be mostly scrub growth of 1 or 2 feet depth. The more distant mountains and those on the west side of the harbour were heavily timbered. In the valleys were patches of bush and small streams of water, brownish in colour. The place was without population, there being no food except that placed in a refuge for shipwrecked persons, and the country to the back being so mountainous and so thickly wooded that only a few persons have ever broken their way through to the east and north. There are said to be wallaby, wombats, and wolves (Tasmanian devil) in the neighbourhood, and also snakes, but we saw none, and fish are reported to be plentiful. We climbed to the top of Morning Hill and Mount O'Brien, and found that ground overlooking Davey Harbour and a sea horizon across the flat ground by Kelly Basin; but the slope of

the ascent made it impossible of access with instruments, as for part of the way the slope was from 35 to 40 degrees.

From the top it was possible to locate probable sites, and it was seen that there were only two, one at Spain Bay near Hilliard Head, and the other Hixson Point, or Sarah Island, in Bathurst Channel, the latter of which Mr. Brooks and Captain Livingstone were already examining. Spain Bay was open to the full force of the ocean, and was also very shallow, so that Hixson Point alone remained feasible. This on examination was found to answer all requirements. It was only 100 feet high, had deep water close in, and, except for a 6-foot bluff on the shore, had an easy gradient. It was protected from the sea by the Breaksea Islands, and from wind on the south by Morning Hill, and on the north by Mount Misery. There was water within a few hundred yards in a small bay where a camp might be set up, with a small amount of bush cutting. The top was flat for some 200 feet by

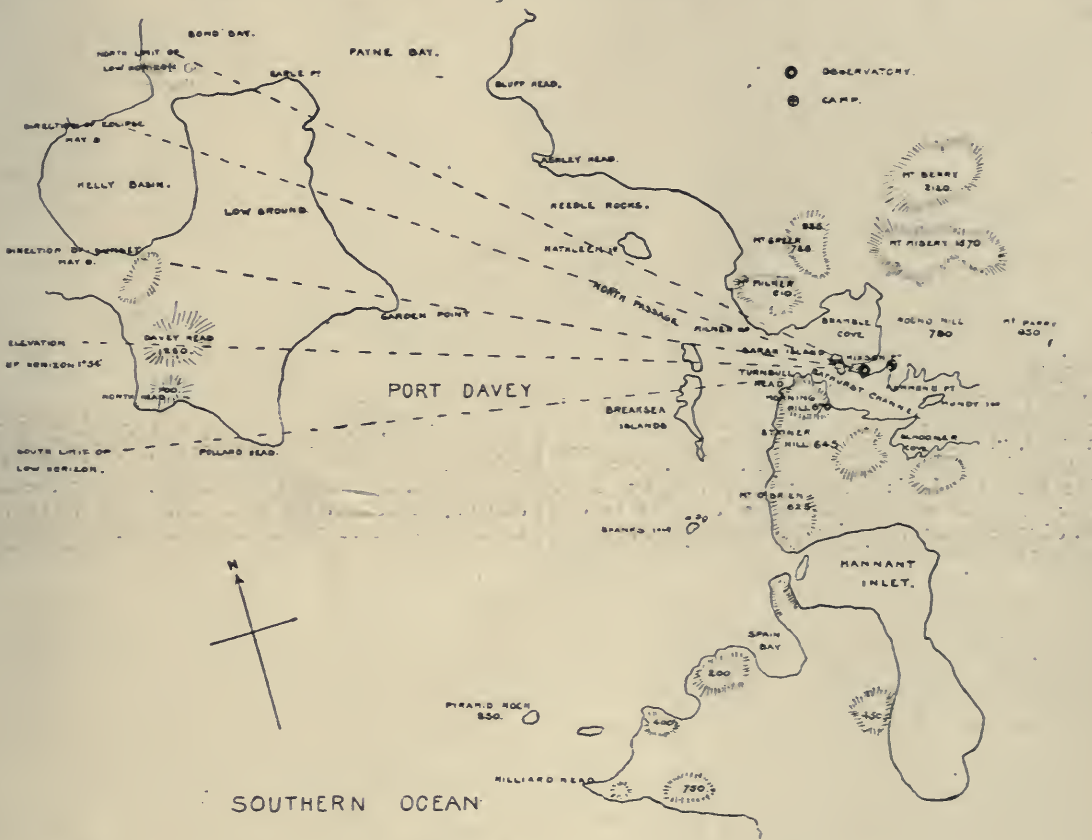


FIG 2.

100 feet, and the angle of view from it covered the horizon from west to north-west, the actual figures for the low horizon being:—

South limit of view ...	98° azimuth from true south			Angle 32°
Sunset on May 9 ...	114°	,,	,,	
Eclipse	123°	,,	,,	
North limit of view ...	130°	,,	,,	

We therefore chose this spot for our eclipse observations, and returned to the ship by mid-day. From Port Davey we steamed along the south coast, passing through isolated rocks many hundred feet high, and along a coast-line of cliffs, sheer from the water's edge and crowned with trees, offering no possible landing, and of absolutely no use for astronomical observations.

Since there were no supplies at Port Davey we have had to arrange for provisions for the period of stay, in addition to tents, photographic materials, kitchen and dining utensils, &c. The danger that weather would prevent the steamer calling in made it advisable not to trust to outside assistance. This has kept us very busy, though we have been given every assistance. Mr. Hughes, of the Union Company, has made arrangements for the *Wainui* to drop us and our kit at Port Davey on April 9, and also to call in twice during our stay before it finally will take us away on May 10 or 11 to Melbourne.

Accompanying the above letter were several photographs of the region about Port Davey, with a large scale map of the vicinity. Three of the above photographs, which, when placed together, form a panoramic view looking towards the direction of the eclipsed sun (azimuth 123°), have been reduced, and are illustrated here in Fig. 1. From this the reader will be able to gather an idea of the appearance of the neighbourhood and the open view in the direction of the eclipse from the observing station at Hixson Point.

Fig. 2 illustrates a general plan of the neighbourhood, and shows, by dotted lines, the various azimuths mentioned in the above letter.

Up to the present time no information is at hand regarding the erection of the instruments, the camp life, and the rehearsals. This will no doubt be received soon, and will form the substance of a later contribution.

In conclusion, it may be mentioned that in the *Westminster Gazette* for May 12, a Reuter cablegram from Melbourne records the observation of the eclipse made at sea on the Oceanic Company's steamer

Corinthic. It reads as follows:—"The eclipse of the sun was witnessed on board the Oceanic Company's steamer *Corinthic,* 480 miles south-west of Hobart. Totality lasted from 2h. 50m. to 2h. 54m. The corona was unexpectedly structureless, being equally distributed round the circumference. There were no prominences, rays, plumes, or streamers. The chromosphere was dark red and of exceptional depth."

William J. S. Lockyer.

SIR WILLIAM HUGGINS, K.C.B., O.M., F.R.S.

One of the pioneers of the new era of astronomy opened by the application of the spectroscope and photographic plate to celestial bodies has just passed into silence, and though the memorial formed by his works remains with us, no new block can be added or detail elaborated by the hand of its builder. It is not given to many men of science to have their scientific careers associated so closely with new developments as was that of Sir William Huggins, whose death on May 13, at eighty-six years of age, we regret to record. It may almost be said that he was present at the birth of celestial spectroscopy; when he commenced his work nearly fifty years ago, he had a virgin field of study before him, so that "nearly every observation revealed a new fact, and almost every night's work was red-lettered by some discovery." It was inevitable that some lines laid down in this early survey required modification as more exact instruments and methods became available, but the observations served their purpose in showing that new regions awaited exploration, and Sir William Huggins lived to lead investigators into the realm thus gained for science, and to stimulate a new generation to study it in detail.

In 1901, a year after Sir William Huggins had been elected president of the Royal Society, an appreciative account of his work was given by Prof. Kayser in these columns as a contribution to our series of "Scientific Worthies." He was then seventy-seven years of age, and had crowned the edifice of his scientific publications by the production of a sumptuous "Atlas of Representative Stellar Spectra." In 1902 his achievements received the highest official recognition by the bestowal upon him of the Order of Merit. While president of the Royal Society from 1900 to 1905, he delivered four addresses in the course of which he described some of the work which the society has done, and is doing, for the nation. Selections from these addresses, with a short history of the Royal Society, were published in volume form in 1906, and the subjects with which they deal were thus brought under the attention of a wider public than that present at the anniversary meetings at which they were delivered. Two of the addresses were concerned mainly with scientific education, and the public interest excited by one of them led the Royal Society to appoint a committee to consider the subject and prepare a report, which was afterwards sent to the existing universities of the United Kingdom, with a resolution adopted by the president and council asking that steps be taken to "ensure that a knowledge of science is recognised in schools and elsewhere as an essential part of general education." It is a matter for regret that this manifesto, which was a sequel to Sir William Huggins's advocacy of the claims of science in modern life, led to no definite result. A fuller knowledge of the conditions at the public schools and universities, and greater precision in the recommendations of the committee, might have gained for him a place among educational reformers who see their causes triumphant.

There is no need now to refer in much detail to Sir William Huggins's activities in the domain of astrophysics, for his work was surveyed in the "Scientific Worthies" article mentioned already. He began his spectroscopic studies with Prof. W. A. Miller in 1864, by the examination of the spectra of a few stars, with particular reference to the identification of their chemical constituents. Nine or ten terrestrial elements were found to exist in the atmospheres of Betelgeuse and Aldebaran, and other elements were suspected. While carrying on these investigations, he submitted a planetary nebula in Draco, close to the pole of the ecliptic, to a spectroscopic examination, and found the spectrum to consist of three bright lines, the brightest of which—the characteristic nebular line—he believed to be coincident with a line due to nitrogen. This identification was afterwards disproved, but there remains to his credit the fact that he was the first to observe the bright-line radiation of some nebulæ.

Sir William Huggins was also the first to apply the Doppler-Fizeau principle to the measurement of radial velocities. He showed in 1867 that motion in the line of sight could be determined by measuring the displacement of spectrum lines in a star or other heavenly body; but though his work, and that to which it gave rise at the Royal Observatory, Greenwich, demonstrated the feasibility of the method, the results were too discordant to be of substantial service to science. Not until Vogel applied photography to the subject, about twenty years later, was real success achieved, and the value of the principle in astrophysical investigations realised.

Photography had been used by Sir William Huggins in cooperation with spectroscopy long before Vogel showed the precision with which radial velocities could be determined by its aid. He was probably the first to obtain a spectrograph of Sirius, in 1863, using a wet plate, though he failed to secure any impressions of lines in the record. After the invention of the gelatin dry plate, several years later, the attempt to secure photographs of stellar spectra was renewed, and success was attained. Using instruments placed at his disposal by the Royal Society, he photographed the ultra-violet series of hydrogen lines in the spectra of six "white stars," this being the first time the series had been revealed, either in terrestrial or celestial chemistry. It is a little surprising, therefore, that he did not anticipate Vogel in the application of photography to the determinations of radial velocities which have led to such valuable additions to our knowledge of binary systems and the gregarious movements of stars.

Not so much is known, perhaps, of Sir William Huggins's work in other astronomical directions as of that in celestial spectroscopy. With Prof. Stone, about 1870, he made some investigations with the object of measuring the heat received from stars, using a thermopile, and concluded that distinct indications of thermal effects due to stellar radiations were obtained; but the results are now known not to be trustworthy. Twenty years later, Prof. Boys, using his far more sensitive radiometer, was unable to find any definite effects from the brightest stars, and only when a more delicate radiometer was used by Prof. Nichols in conjunction with the great telescope at the Yerkes Observatory was it possible to secure distinct deflections due to radiation from stars like Vega and Arcturus.

Such revision as this of early observations is, we take it, a concomitant of scientific progress. However well an investigator may build, the iconoclast, with superior equipment and deeper knowledge of causes of weakness of conclusions, overthrows the edifice and erects his own pillar in its place. There

is frequently little left of the original foundation, yet each structure represents an advance upon that which it supersedes. Sir William Huggins recorded in 1867 that he had detected the presence of water vapour in the atmosphere of Mars, and re-affirmed his observation later at his observatory at Tulse Hill, but critical inquiry afterwards showed that the conclusions had been drawn too hastily. While, however, those observations must be discarded, we have the recent investigations at Prof. Lowell's Flagstaff Observatory giving clear evidence of the presence of aqueous vapour in the Martian atmosphere. So, like a coral on its base, rises the living body of science upon the monument of past effort. Cemented upon the rock of nature, Sir William Huggins stretched out his hands toward the stars, and if a succeeding generation is able to examine the secrets of the heavens more closely than was possible in earlier days, let it remember the patient pioneer work required to form the base of the pinnacle from which observations can now be made. R. A. G.

PROF. STANISLAO CANNIZZARO.

BY the death of Cannizzaro, another link between the chemistry of to-day and that of the mid-Victorian era has been broken—a link which perhaps more than any other served to connect two well-defined and sharply differentiated epochs in the history of nineteenth-century chemistry. Cannizzaro was not a great discoverer in the ordinary sense of that word; the number of his published researches is few, and the field of inquiry he cultivated comparatively restricted. His greatest discovery, indeed, was his own countryman, Amedeo Avogadro. The fundamental conception of Avogadro that the gaseous laws of chemical combination—the laws associated with the names of Dalton and Gay-Lussac—could be explained by the simple hypothesis that equal volumes of gases, under identical conditions of temperature and pressure, contain the same number of molecules was as the seed which fell upon stony ground. Even the efforts of Ampère—a man of far more influence in his generation—to cause it to fructify had no immediate effect. Berzelius, for a time, dimly apprehended the potentiality of the supposition, but he eventually lost his way under the blind guidance of dualism, and led Europe wrong for a quarter of a century. The German school, it is true, mainly under the direction of Gmelin, gradually shook itself free from dualism, but it wandered still further from the true faith, and by the middle of the nineteenth century chemical theory was utterly befogged, and its doctrine bristled with inconsistencies, contradictions, and anomalies.

Cannizzaro appeared at the psychological moment, as the phrase goes. In its effect, the publication, in 1858, of his "Summary of a Course of Chemical Philosophy" created a revolution in chemical thought hardly less momentous than that which followed the appearance of Dalton's "New System." The publication of a syllabus of a lecture course is a simple enough occurrence, and perhaps never before marked an epoch. But its effect in this case was instantaneous and profound. Cannizzaro demonstrated that the hypothesis of his forgotten countryman constituted the means of placing the most important of all chemical constants on a definable basis; it rendered our conceptions of atoms and molecules, atomic weights and equivalents, gaseous volumes and valency, and all that is associated with or consequent upon these conceptions, logical and consistent.

It is not too much to say that Cannizzaro's intervention at this time saved the position of the atomic theory. The early 'sixties of the last century were a period of much perturbation; there was then a sort of parting of the ways. Williamson laboured to stem the tide of infidelity, but many were unconverted, and some even hardened their hearts. We hear little or nothing to-day of the scepticism which was fashionable among the young bloods of fifty years ago. It is largely due to Cannizzaro that our faith has been strengthened and purified.

There is something dramatic in the circumstance that Cannizzaro should have passed away at the time that all Italy is celebrating the achievements of Garibaldi and his never-to-be-forgotten Thousand in effecting the establishment of Italian unity, a cause in which Cannizzaro had himself struggled and suffered, and in which he was destined to take a share in shaping to a successful issue.

Cannizzaro was born at Palermo in 1826, where his father was president of the High Court of Chancery. He was originally intended for medicine, but under the influence of Melloni he began the study of natural science, more particularly chemistry, under Piria, in whose laboratory he became *préparateur*. The revolution of 1848 found Cannizzaro in Messina, and the youth of twenty-two an officer of artillery and a member of the Sicilian Parliament. For nearly nine months the revolutionaries held out against Ferdinand's army, but Messina was eventually bombarded and sacked, and Cannizzaro and what remained of his band were driven to Taormina. With the disaster of Novara and the abdication of Charles Albert, the Sicilian movement collapsed; the insurgents retreated to Catania, and thence by Castrogiovanni to Palermo, where Cannizzaro succeeded in getting on board a Sicilian frigate, and in escaping to Marseilles. He was now almost destitute, but friends helped him to Paris, and, thanks to Cahours, he found a place in Chevreul's laboratory in the Jardin des Plantes, and began the study of the amines in conjunction with Cloëz. In 1851 he became professor of physical chemistry at Alessandria, in Piedmont, where he discovered benzyl alcohol and worked with Bertagnini on anisic alcohol. In 1855 he was elected to the chair of chemistry at Genoa, where he drew up the famous "Summary" of which mention has been made.

At this time the cause of Italian unity was in the ascendant, and by 1860, thanks to the affairs of Magenta and Solferino, the consolidation of Central Italy was complete. Sicily was once more ablaze, and before the middle of May Garibaldi and the "Mille" had effected its liberation. Cannizzaro immediately returned to Palermo, and threw himself into the work of organising the political future of the island and its relation to Italian unity. He then resumed his academic work at Genoa, but in the following year he was invited to the chair of chemistry at Palermo, where he remained ten years, taking an active share in the management of the University and serving for a time as rector.

In 1871 he was called to the University of Rome, and made a senator of the kingdom. As director of the Chemical Institute at Panisperma he gave, session after session, for nearly forty years, systematic courses of lectures on general and organic chemistry, and practically every Italian chemist of note now living passed through his laboratories and worked under his inspiration and direction.

Cannizzaro was a foreign member of many learned societies, and of nearly every academy in Europe. At the time of his death he was the oldest foreign member of the Chemical Society of London, having been elected in 1862. In 1872 he delivered the Faraday lecture to the society, giving a charming and graceful exposition of the genesis of the doctrine with

which his name will for ever be associated. In 1889 he was made a foreign member of the Royal Society, and two years later was awarded the Copley medal for his services to chemical theory. On the occasion of his seventieth birthday, NATURE published an appreciation of his labours, in the series of its "Scientific Worthies," accompanied by a portrait (No. xxx., 1897). From this account it may be permitted to give the following extract:—

"Cannizzaro, when compared with such men as Berthelot and certain of the leaders of the German schools of chemistry, or even with some of the younger generation of Italian chemists, cannot be called a voluminous writer. In all, about eighty memoirs have proceeded from his laboratory. It is on the special quality and character of his published work, rather than on its extent, or on the range and variety of its subject-matter, that his fame depends. In this respect he resembles the late August Kekulé. The names of both men will for ever be associated in the history of chemistry with the promulgation of generalisations which mark epochs in the development of chemical science." T. E. T.

PROF. E. VAN BENEDEN.

EDOUARD VAN BENEDEN, who died on April 28, adds another to the already long list of illustrious zoologists who have left us since last summer. He belongs essentially to the epoch which brought forth Anton Dohrn and Alexander Agassiz, whose loss we have so recently mourned, and, like them, he participated in the triumphs of biological achievement which mark the 'sixties, 'seventies, and 'eighties of last century. If Dohrn may be called the founder of marine laboratories, and Agassiz one of the originators of modern oceanic research, van Beneden may surely be styled the father of modern cytology. For it was he who discovered the exact similarity of the male and female nuclei in fertilisation, and the halving of the number of chromosomes in gametogenesis.

Born at Louvain on March 5, 1846, he was the son of that distinguished zoologist Prof. P. J. van Beneden, of the Catholic University of Louvain. He was educated at Louvain in the university, and later he studied in Germany, especially at Würzburg under Kölliker. He succeeded the zoologist Lacordaire at Liége, and was put in charge of the course of zoology in the faculty of sciences in 1871, at the age of twenty-five. In 1872 he was appointed professeur extraordinaire, and in 1874 professeur ordinaire. This position he held until his death, and made full use of the opportunities it afforded him of advancing the interests of his favourite science. Though his principal achievements were in the domain of mammalian embryology and cytology, his work covered a wide field. He was the first to give an accurate account of the structure and life-history of those strange parasites of the Cephalopoda, the Dicyemida (1876 and 1882), and he founded the conception of a group between the Protozoa and the Metazoa, to which he gave the name of Mesozoa, a conception which has largely influenced speculative zoology. In conjunction with his pupil Julin, he carried out some interesting researches on the development of the Tunicata, and one of the last of his zoological works was an important memoir on the Anthozoa of the Plankton expedition. He is also the author of researches on Gregarines, Crustacea, Limulus, Cetacea, and other groups.

His work on mammalian embryology, to which he was apparently led by his researches on the ovum, chiefly concerns the rabbit and the bat. His first papers on this subject, "La Maturation de l'Œuf, la Fécondation et les Premières Phases du Développement embryonaire des Mammifères" (1875), and "Recherches sur l'Embryologie des Mammifères" (1880), were noteworthy for his description of the cleavage and for the comparison he instituted between the fully segmented ovum and the gastrula. Though these speculative views proved untenable, and were eventually given up by him, they had a considerable influence in stimulating interest in the subject, and so leading to further researches. Later (1884) he gave, in conjunction with Julin, the first complete elucidation of the fœtal membranes of the rabbit and certain other types, and he was the first to name the pro-amnion and to explain its significance. He was, further, successful in making out the early stages of bats, and as far back as 1875 he directed attention, we believe for the first time, to the remarkable method of impregnation in these animals. His paper on the development of bats, published in the *Anatomischer Anzeiger* for 1899, contains the results of many years' observations, and is regarded by embryologists as the most far-reaching of all his mammalian work.

But although van Beneden's name will always hold a prominent position in the history of embryology, it is by his researches on the minute structure of living matter that he will be chiefly remembered. Of cytology, as this branch of science is now called, he will always be hailed as one of the fathers. He early directed his attention to the subject, and his first important published work, "Recherches sur la Composition et la Signification de l'Œuf, Mémoire couronné de l'Académie royale des Sciences de Belgique," published in 1870, dealt with it. This was followed in 1875 by his memoir, already referred to, on the maturation and fecundation of the ovum of the rabbit, and in 1883 by his greatest work, "Recherches sur la Maturation de l'Œuf, la Fécondation et la Division cellulaire." Then follows a lull in his activity, caused, no doubt, by the terrible accident which happened to him about this time on the Eiger, and as a result of which he was unconscious for three weeks and incapacitated from work for two years, and it was not until 1887 that he published, in conjunction with A. Neyt, his "Nouvelles Recherches sur la Fécondation et la Division mitosique chez l'Ascaride mégalocéphale." All his great achievements in cytological research are recorded in this series of remarkable papers. They prove, beyond all possibility of doubt, the right of Edouard van Beneden to take his place in that select band of great original observers to whom science owes her progress.

By his use of *Ascaris megalocephala* as the material of his investigation, he introduced a means of research which, in his own hands and those of his followers, led to the most important results. He was the first to show, for the ovum, that the chromatic threads are a portion of the network existing in the nucleus. He laid special stress upon the fact that the two daughter chromosomes were alike to the smallest detail, and he first pointed out that they pass to opposite poles of the spindle. He discovered the *corpuscule centrale* in 1876 (first seen, it is true, by Flemming in 1875), and first demonstrated its importance in cell division. He was also the first to show that it is in many cases, if not in all, a permanent organ of the cell (1885 and 1887). He also discovered the *sphère attractive.* Both these structures later received other names, the former being known as centrosome and the latter as centrosphere; but whatever names be applied to them—a matter of no importance—the fact remains that they

vere discovered, and their importance appreciated, by an Beneden.

Finally, and this, perhaps, is the greatest discovery ssociated with his name, he showed, in 1883, that in he last gametogenic divisions by which the ovum is roduced, the number of chromosomes of the nucleus ecomes reduced to one-half the original number, nd the like fact for the spermatozoon was disovered in 1884 by him, working in conjunction with . Julin. Though it cannot be asserted that he was he first to give a complete account of the morphology f fertilisation, yet it may fairly be said that he went s near to that as any other worker, and that he was ne of the three zoologists whose discoveries led to he complete elucidation of that phenomenon. Lastly, e must not forget to mention that he founded and dited the *Archives de Biologie*, in which some of his most important work was published.

Van Beneden was a strikingly handsome and disinguished-looking man. His splendid figure will not eadily be forgotten by those who were present at he Darwin centenary celebration at Cambridge last ear. He was a keen and active sportsman, and his proclivities in this direction often led him far afield—o Sweden for reindeer and, as we have seen, to Switzerland for climbing. He was a lauréat and correspondant of the Institut de France, correspondant of the Acadamies of Berlin, Vienna, and St. Petersburg, foreign member of the Academy "Dei Lincei" of Rome, and an honorary member of many other similar institutions in different parts of the world. He was an honorary doctor of many universities, including those of Oxford and Cambridge, and had many other titles and honours. A. S.

NOTES.

The next meeting of the Royal Society will be held on Thursday, May 26, when the Croonian lecture will be delivered by Prof. G. Klebs on "Alterations of the Development and Forms of Plants as a Result of Environment."

Owing to the lamented death of King Edward, the Chemical Society's banquet to the past-presidents who have completed their jubilee as fellows has been postponed from May 26 to the autumn. We are also asked to announce that the conversazione of the Entomological Society of London, fixed for Friday, May 27, is postponed indefinitely.

The annual May lecture of the Institute of Metals will this year be delivered by Prof. Gowland, F.R.S., vice-president of the institute, who will take as his subject "The Art of Working Metals in Japan." The lecture will be given on Tuesday, May 24, at 8.30 p.m., at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W. Tickets admitting visitors may be had gratuitously on application to the secretary of the institute, Mr. G. Shaw Scott, Caxton House, Westminster, S.W., to whom applications should be made not later than Saturday next.

Two meetings—the first with Lord Verulam in the chair—were held on Friday in St. Albans to support the scheme of the society for excavating the site of Verulam during the ensuing summer and autumn. The site covers close on 200 acres, and although the Roman walls and other buildings were used as a quarry in obtaining materials with which to construct St. Albans Abbey, the greater part of Verulam is unique in that it has never been built upon. The beheading of the proto-martyr Alban, together with other circumstances, suggests that remains of early Christian churches may be discovered; and, in any case, the theatre and forum are known to have been larger than any other similar buildings in England.

On Tuesday, May 24, Prof. Love will begin at the Royal Institution a course of two lectures on "Earth Tides," the second to be delivered on Monday, May 30, and on Thursday, May 26, Dr. W. Rosenhain will deliver the first, and on Wednesday, June 1, the second, of two lectures on "Alloys"; on Friday afternoons May 27 and June 3 Dr. D. H. Scott will deliver the remaining two of his course of three lectures on "The World of Plants before the Appearance of Flowers." The Friday evening discourse on May 27 will be delivered by Captain R. F. Scott on "The Forthcoming Antarctic Expedition," and on June 10 by Dr. H. Deslandres on "The Progressive Disclosure of the Entire Atmosphere of the Sun" (in French).

France seems inclined to follow the example of Prussia in forming a Government Department for the Preservation of Natural Monuments. Last October an International Congress for the Protection of Landscape was held in Paris, the German Ambassador being one of the vice-presidents. The Prussian organisation for the preservation of nature—the term "Natural Monuments" referring to natural scenery and indigenous fauna and flora—was highly praised by French men of science, and it was proposed to take steps for the institution of a similar system in France. Prof. Miyoshi, of Tokyo, in a brochure laid before the conference, speaks highly of the Prussian movement, and invites Japan to take a similar precaution. Prof. Kumm, of Danzig, illustrated the working of the statute against disfiguration of scenery. Of particular interest was Dr. Hermann's paper on natural parks for the protection of animal and plant life, which have long been a German institution. The second Conference for the Preservation of Natural Monuments in Prussia has also just been held at Berlin. It is worth remark that the German Press and public take a keen interest in this useful work. There is, we may add, plenty of scope for such work in the United Kingdom; but it must be done soon, before the building speculator and the municipal engineer have quite exterminated nature in these islands.

The number of *L'Anthropologie* for March-April, under the title of "Les Sofs chez les Abadhites," of North Africa, contains the first portion of an important study of tribal sociology by Dr. J. Huguet. The vague term Sof is defined by the writer as "the reunion of all those individuals who, by reason of community of origin, needs, and political interests, have been forced to associate for purposes of attack and defence." The political influence of associations such as these has recently attracted much attention from the officers responsible for the control of these often unruly tribes.

In the May issue of *Travel and Exploration* Miss E. C. M. Browne describes an adventurous journey by two ladies to the famous sacred lake Manasarowar, in Tibet, which has been hitherto visited only by a comparatively small number of Europeans. Evidently recent British action in Lhasa has borne fruit so far west as Manasarowar. The head Lama of the local Gomba was very friendly, and went so far as to allow the Bhotiya coolies following the camp to shoot birds in the holy waters, an unusual concession on the part of a Tibetan Buddhist, who, in theory at least, is much opposed to taking animal life.

In *L'Anthropologie* for March-April MM. E. Cartailac and l'Abbé H. Breuil continue their survey of the paintings and engravings found in the caves of the Pyrenees. The caves described in this article are those of Gargas, not far from Montrejeau, and Bédailhac and Pradières, near Tarascon. The first of these contains a remarkable series of paintings and engravings, depicting hand-marks, animals such as the elephant, bison, horse, and what seems to be a rude human figure, resembling other European specimens of Palæolithic art, as well as that of the natives of Australia and the South African Bushmen. A similar collection of examples of primitive art from caves once occupied by Bushmen on Mt. Silozwana is described by Messrs. Mennell and Chubb under the title of "Some Aspects of the Matopos" in the first part of vol. viii. (1908) of the Proceedings of the Rhodesia Scientific Association, just received. The figures of the giraffe, guinea-fowls, and flying ants are particularly realistic, and supply excellent examples of primitive native art.

The Choctaw of St. Tammany Parish, in Louisiana, the now scanty remnants of a once famous tribe, are described by Mr. D. I. Bushnell, jun., in the forty-fifth Bulletin of the Smithsonian Institution. They have now forgotten most of their characteristic industries—pottery and basket-making—and have lost the art of fishing, most of their needs being supplied from the nearest store; but though they have been for a long period subjected to Christian influences, they retain many of their primitive beliefs. Thus a solar eclipse occurs when the sun is resting and cleaning himself from the accumulated smoke of his fires. Thunder and lightning are produced by two great birds, and when the female is laying an egg in her nest in the sky there is a thunderclap. The good spirit, Aba, takes to his heaven the spirits of all tribesmen save those dying by effusion of blood and murderers. The evil spirit, Nanapolo, wanders in the recesses of the forest, and though he is feared, he never succeeds in gaining possession of the soul of a Choctaw. They have practically lost their belief in witchcraft, and have never assimilated the practices of Voodooism, so popular among the negroes around them. Mr. Bushnell has excavated a series of mounds which throw some light upon their primitive culture.

The great flights of crossbills which visited this country and the Continent last summer and autumn have, in our islands at any rate, remained in many places to breed. In the May issue of Witherby's *British Birds* a large number of instances of such nesting are recorded, and it is confidently expected that many more will follow. The localities include the Southampton district, Wickham, the New Forest, Kent, Staffordshire, Suffolk, Surrey, and Sussex. The nests were mostly, or invariably, built in Scots firs, those near Burley, in the New Forest, being placed in the forks of horizontal boughs at a height of some 30 feet from the ground and a dozen feet from the stem. It is suggested that an unusual abundance of Scots-fir seeds may have led to the visitation.

Dr. K. Deninger, in vol. xviii., part i., of the *Berichte d. Naturfor. Gesellschaft zu Freiberg*, has done good service in demonstrating the marked distinction between the babirusa of Boru and its relative of Celebes. The original *Sus babirussa* of Linnæus came, it appears, from Boru, but the *Babirussa alfurus* of Lesson's "Mammalogie," which was supposed by its describer to come from the same island, and to be identical with the Linnean species, is based on Celebes specimens. For the Boru species Dr. Deninger takes the name *Babirusa babirusa,* while for its Celebes representative he proposes the new title *B. celebensis,* although in our opinion he ought to have retained Lesson's *B. alfurus.* Until the author brought home specimens, the Boru babirusa seems to have been represented in European museums only by a few skulls, the distinctive peculiarities of which were not recognised. It is distinguished by its nearly smooth hide, of which the colour in adult males is greyish-brown above and light brown below, and also by the thick coat of short bristly hairs, which becomes thickest at the root of the tail. The general colour is whitish-grey, tinged, especially on the head, with yellow. Females and young males are darker. The Celebes species, on the other hand, has the well-known rugged and furrowed hide almost naked, and brownish-grey in colour. The skull of the Boru babirusa is short and wide, with the extremities of the nasals not narrowing to a sharp point between the sheaths of the upper canines in the manner characteristic of its relative in Celebes, and there are also differences between the tusks of the two species. Dr. Deninger, who adopts Stehlin's theory that the bunodont dentition of the Suidæ is derived by degeneration from a selenodont type, concludes by expressing the opinion that Babirusa is nearly related to the Siwalik Merycopotamus, both genera agreeing in the parallel direction of the two lines of cheek-teeth, the general form and small size of the crowns of these teeth, the shape and direction of the tusks, and certain other features.

The Board of Agriculture has taken advantage of the powers conferred upon it by the Destructive Insects and Pests Acts, and has issued an order affecting the following:—The vine louse (*Phylloxera vastatrix,* Planchon), the San José scale (*Aspidiotus perniciosus,* Comstock), the Mediterranean fruit fly (*Ceratitis capitata,* Wiedemann), the Colorado beetle (*Doryphora decemlineata,* Say), the large larch sawfly (*Nematus erichsonii,* Hartig), the potato moth (*Lila solanella,* Boisduval), the gipsy moth (*Liparis* [*ocneria*] *dispar,* Linné), the brown tail moth (*Euproctis chrysorrhoea,* Linné), the nun moth (*Liparis monacha,* Linné), the cherry fly (*Rhagoletis cerasi,* Linné), the narcissus fly (*Merodon equestris,* Fabricius), black knot (*Plowrightia morbosa,* Saccardo), wart disease or black scab of potatoes (*Synchitrium endobioticum,* Percival), tomato-leaf spot (*Septoria lycopersici,* Spegazzini), melon or cucumber canker (*Mycosphoerella citrullina,* Grossenbacher), and American pear blight (*Micrococcus amylovorus,* Burrell). Under the provisions of the Act any person selling or planting any seed, cutting, plant, &c., attacked by any of these pests is liable to a penalty of 10*l.* A like penalty is incurred if anyone fails to notify the proper inspectors when any of the pests appear in his garden, or if he omits to carry out the measures specified by the Board for the prevention of the spread of the pest. The inspector may enter any premises where he has reason to suppose one of these pests occurs and examine any plants. He may go further, and order the destruction of the plants affected if the local authority consents to pay compensation. This is the part of the Act that has been most criticised, and it still remains to be seen how much good is done when the most effective, if also the most drastic, method of treatment may be excluded. But the order shows that the Board is alive to the necessity for action, and it will no doubt discover a way of getting over this particular difficulty. If the order constitutes a new terror for amateur gardeners and careless nurserymen it also emphasises the necessity for horticultural instruction in the schools, and justifies the evening classes held in many of the counties.

A curious manna-like incrustation or wax collected on twigs and leaves of *Elaeodendron glaucum* is described by

Dr. D. Hooper in the Journal of the Asiatic Society of Bengal (vol. v., No. 9). It has been identified as the secretion of *Phromnia marginella*, an insect passing in India under the name of the ghost bug. The substance contains sugar in the form of dulcitol, which the author refers to a special secretion in the plant.

An article in Engler's *Botanische Jahrbücher* (vol. xliv., part i.) by Dr. R. Knuth, on the formation of hybrids in the genus Pelargonium, should be interesting to horticulturists and botanists alike. The large number of Pelargonium hybrids contrasts greatly with the three hybrids known for Geranium and two for Erodium. It is strange to find that five sections of the genus furnish no hybrids, while crosses between species in different sections are not uncommon. The author remarks that, as a rule, there is no fusing of parental characters, but more often one supplies the leaf and the other the flower characters in the hybrid. The "English" pelargoniums, known in this country as decorative or fancy, are attributed to crosses between *grandiflorum* of the section Polyactium, and the species *cucullatum*, *cordatum*, and *angulosum* of the section Pelargium. Dr. Knuth recognises the excellent work of English horticulturists, and places a high value on the classic work of Sweet on the Geraniaceæ, published in 1815.

The composition of Indian rice has been investigated by Mr. David Hooper, and the results are published as No. 5 of the *Agricultural Ledger*. Rice cultivation is the most important of the agricultural industries of India, more than seventy million acres being annually under this crop. There are a number of varieties of grain differing in size, shape, colour, and other properties, not all being equally suitable for culinary purposes. Thus a variety known as *kauk-nyin* is so glutinous that it will not stand the boiling required by ordinary rice, but is made into various kinds of puddings and sweetmeats. It is frequently boiled in bamboo tubes, to be eaten cold by travellers; when required, the bamboo is peeled off, and a long roll of rice appears which forms a palatable substitute for bread. Taking the 159 samples as a whole, the percentage of carbohydrate varied between 92·2 and 82·2, of protein between 11·4 and 6·06, of fat between 3·6 and 0·11. The fibre rarely exceeded 1 per cent., and was usually round about 0·5 per cent.; the ash usually fluctuated between 0·5 and 2 per cent. This series of analyses of rice is probably the most complete that has yet been executed.

Prof. R. Marek contributes an important paper on the position of the upper limit of the forest growth in the eastern Alps, and its relation to the elements of climate, to Petermann's *Mitteilungen* (p. 63). The general conclusion arrived at is that the importance of mean atmospheric temperature has hitherto been greatly overestimated, and that such factors as rainfall and direction and force of wind are essential causes determining the altitude of the forest line.

The Proceedings of the Royal Society of Edinburgh (vol. xxx., p. 183) contain a paper by Dr. W. A. Caspari, of the *Challenger* Office, on the composition and character of oceanic Red Clay. Dr. Caspari gives the results of analyses of thirteen samples of Red Clay obtained from the different oceans in depths varying from 1900 to 3100 fathoms, and discusses the peculiarities of each. It is established, generally, that Red Clays originate, in the main, from the degradation of acid and basic volcanic glasses, and that the chemical processes involved cannot differ in essence from those associated with the subaërial weathering of silicates. A feature of deep-sea "weathering" is that it takes place under conditions which admit of finality; in the Red Clay areas there is a temperature of 1° C. to 3° C., a pressure of 400 to 600 atmospheres, and a uniform medium, sea-water, which have scarcely changed for millions of years. As a result, a degradation product of much the same composition is found all over the globe, and it is to be observed that it is a more acid silicate than the corresponding continental material.

The Bulletin of the Philippine Weather Bureau for August, 1909 (recently received), contains an interesting note on the frequency of local earthquakes in relation with atmospheric pressure in Manila in 1902–8. As "local earthquakes" are designated the so-called instrumental earthquakes the records of which traced by the microseismograph show that their point of origin was in the locality, or very close to it. During the years under consideration 796 such disturbances were recorded at the observatory, and a table showing graphically their mean hourly frequency exhibits clearly two principal maxima and minima, and one secondary maximum and minimum. When this curve is smoothed by showing the frequency for three-hour periods, its parallelism with that of the double daily oscillation of atmospheric pressure shows that "at Manila the highest pressures are more favourable to the occurrence of instrumental earthquakes than low pressures." Prof. F. Omori, the eminent seismologist, has attributed the reason of such parallelism to the fact that in all probability these local earthquakes have their origin at very shallow depths, and may be closely connected with daily changes of pressure exerted by the atmosphere on the earth's crust (see Bulletin of the Imperial Earthquake Investigation Committee, Japan, vol. ii., p. 105).

"The Cause of the Vertical Movements in the Atmosphere" is the title of an interesting paper by Prof. W. Trabert in the *Sitzungsberichte* of the Vienna Academy of Sciences of December 2, 1909. The inquiry is based upon the observations of the upper air made at Lindenberg during the month of January, 1909. The diagrams, which exhibit, *inter alia*, the isotherms and lines of equal potential temperature up to an altitude of 5000 metres, show that at times tongues of low temperature extend downwards from the upper regions, and that others of higher temperature extend from below upwards, so that areas of high and low temperatures become intermingled. Among the results arrived at we may mention the following:—In a warm column of air the movement is upwards, and *vice versa*. The ascending movement causes the air-pressure to fall, and conversely. If cyclones and anti-cyclones are thus caused, the air already cooled is dynamically carried higher up, or the warmed air transferred further downwards, causing fresh vertical motion; the origin of cyclones and anti-cyclones is therefore thermic and dynamic. The pendulum-like upward and downward movement of the air is due to aqueous vapour, and the latent heat set free by its condensation furnishes the energy for the maintenance of the vertical circulation.

The importance of the coherer as a detector in radiotelegraphy amply justifies the large amount of attention which has been paid to it by experimenters during the last few years. Attention has been directed in these columns to the work of Mr. G. W. Pierce (*Physical Review*, vol. xxix., and references there) and of Mr. L. W. Austin (Bulletin of the Bureau of Standards, vol. v.). In the *résumé* of communications made to the Société française de Physique on March 18 there are abstracts of two further

papers by M. Tissot and M. Blein respectively. Both direct attention to the influences of the thermoelectric properties and the variation of the resistance with temperature of the materials used on their behaviour as coherers, but Dr. W. H. Eccles, in a paper read before the Physical Society of London on March 11, showed that the whole of the properties of coherers could be explained, both qualitatively and quantitatively, by the Joule and Peltier heat generated at the junction, and its effect on the resistances of the materials forming the contact.

VOL. vi. of the "Collected Researches of the National Physical Laboratory" contains 200 pages quarto, and consists of reprints of fourteen papers by members of the staff which have appeared in the pages of the technical Press or the proceedings of scientific societies, most of them during the year 1909. Several of these papers have already been noticed in these columns, but we should like to direct attention to the report of the committee appointed by the Institution of Naval Architects to carry out the scheme for establishing a tank at the laboratory in which the experiments necessary for the advance of British shipbuilding might be carried out. Ten experimental tanks are already in use throughout the world, Japan possessing one, but most of them are owned by private firms. An advisory committee of naval architects has been appointed, which will draw up a scheme of work to be done in connection with the problems now awaiting solution.

A SPECIMEN bottle of a concentrated combined toning and fixing bath, issued under the name of "Combino," has been sent for examination by Mr. P. F. Visick, 30 Finland Road, Brockley. It gives good colours, and as it is only necessary to place the print as taken from the frame into the solution until the desired colour is obtained, it makes the use of ordinary silver printing-out paper as simple as the self-toning papers now so common. It is a gold-toning solution, and the maker claims that it is stable when either concentrated or diluted for use, and that double-toning, that is, a variation of colour according to the depth of the printing, is impossible. It is issued in 4-oz. bottles at one shilling, and is diluted to five times its bulk for use.

THE changes undergone by stored coal are of considerable importance, both from the point of view of liability to spontaneous combustion and loss in calorific value. A recent Bulletin (No. 38, Series 1909) from the University of Illinois Engineering Experiment Station, by Messrs. S. W. Parr and W. F. Wheeler, is devoted to the consideration of this subject. A critical abstract of all the earlier work on the weathering of coal is given. This is followed by a detailed account of experiments made to determine the amount of disintegration and the changes in weight and calorific value occurring in the grades of coal found in Illinois and in the neighbouring States under different conditions of storage. The losses in calorific value for coal stored under water were found to be less than with the usual storage in air, but the differences were not great enough to warrant any changes in present storage methods from this point of view alone. Storage under water gives protection against spontaneously ignited fires, and also lessens breakage losses, and hence may be worth while resorting to in certain cases.

MESSRS. REYNOLDS AND BRANSON, LTD., have just issued a comprehensive catalogue of photographic requisites containing particulars of many new cameras and accessories.

A WORK on the birds of Dumfriesshire, by Mr. H. S. Gladstone, will shortly be published by Messrs. Witherby and Co. The book will give an exhaustive account of the present-day status and past history of all the birds of the county, and will be illustrated by photographic plates and a map. It will be published by subscription, and in a strictly limited edition.

AN Aviation Association of Ireland has been formed, with Mr. J. B. Dunlop as president, Dr. W. E. Lilly and Mr. J. C. Peary as vice-presidents, and Mr. D. O'B. Gill, 19 Herbert Street, Dublin, as honorary secretary. A lecture was delivered before the association on February 8 by Dr. Lilly, and has now been reprinted by the *Motor News*, of Dublin.

MESSRS. J. AND A. CHURCHILL have a new edition of vol. ii. of "Allen's Commercial Organic Analysis" just ready for publication. This volume has been re-written under the editorship of Dr. H. Leffmann and Mr. W. A. Davis. The subjects are:—fixed oils, fats and waxes, special characters and methods, butter fat, lard, linseed oil, higher fatty acids, soap, glycerol, cholesterols, wool fat and cloth oils.

A NEW catalogue of lenses has just been issued by Messrs. J. H. Dallmeyer, Ltd. Among the new types of lenses of which particulars are given are a new series of Dallmeyer stigmatics, the single components of which are dissimilar and may be used separately; improved forms of the well-known "Adon" lens, which gives, for the same camera extension, a much larger picture than an ordinary lens; and a new telephoto combination working at $f/10$, and giving variable magnification. The capabilities of the various lenses and combinations are illustrated by some striking pictures.

OUR ASTRONOMICAL COLUMN.

HALLEY'S COMET.—The observations of Halley's comet during the present month have shown that, in brightness, it has at least come up to general expectation. Numerous amateur observers report having seen it as a fairly conspicuous object before dawn.

If Dr. Ristenpart's calculated time for perihelion is correct, the comet transitted the sun between 3h. 4m. and 4h. 4m. this morning (May 19), and any special phenomena which could be caused by the passage should be fully reported to some competent authority. From Dr. Holetschek's results it appears likely that the brightest part of the tail would not extend so far as the earth, but meteors from the outlying, and possibly curved, extremity should be looked for, carefully noted, and reported. Recent observations indicate, however, that the tail is quite long enough to extend past the earth.

Mr. G. Gillman reports that he has continued his observations at Aguilas, Spain, on each successive morning, and found that at 3h. 20m. on May 13 the tail was particularly well defined. It was visible to the naked eye almost to a line joining θ Pegasi and α Aquarii, which means that the apparent length was some 43°. This is the greatest length yet recorded by him.

Mr. C. Leach also sends another sketch showing the extent of the tail as he saw it with the naked eye at 3h. 45m. a.m. on May 8. This shows the head of the comet in line with α Andromedæ, γ Pegasi, and Venus, with the tail extending, nearly parallel to the south side of the Great Square, to a greater length than the distance between γ and α Pegasi; the tail was perfectly straight. Mr. Leach also sends a sketch and note, taken from a local paper, describing the comet as seen by Prof. Attilio Sesta, at Palermo, at 3h. 25m. on May 8. This corroborates Mr. Leach's own observation, and adds that the nucleus was very bright (visible until 5 a.m.), and that the diaphanous tail exhibited rectilinear margins which formed a small angle at the head.

A number of positions of the comet during November-February are published by Dr. Rambaut in the Monthly Notices (lxx., 6). The places were determined from photographs, taking astrographic stars for reference points.

In *Astronomische Nachrichten*, No. 4408, Herr J. Franz considers the passage of the earth through the tail and

the possibilities of meteor showers at the time. For different values of $1-\mu$ he finds that possible collisions may occur at May 19·442, 19·115, and 18·892. The corresponding radiants of possible small showers are near η Piscium, ρ Piscium, and β Arietis.

In the supplement to No. 4407 of the same journal a telegram from Prof. Pickering announces that Dr. Wright, at Lick, photographed the spectrum on April 29, and found the sodium D lines bright; this is announced as a recent development. An observation by Prof. Frost and Dr. Slocum on April 14 showed a distinct continuous spectrum for the nucleus, with no trace of bright lines or bands.

THE SPECTRA OF COMETS.—Further laboratory results bearing on the nature of cometary spectra are published by Prof. Fowler in a paper appearing in No. 6, vol. lxx., of the Monthly Notices.

Among other things, it is now shown more definitely that the tail spectrum is produced by an oxide of carbon, probably the monoxide. With sufficient density this compound gives the "Swan" spectrum, the most common feature of cometary spectra, whilst at very low pressures —0·01 to 0·005 mm.—the "tail spectrum" is developed. The addition of a trace of nitrogen introduces the cyanogen bands into the high-pressure spectrum, and the kathode bands of nitrogen, such as were found in the spectrum of the tail of Morehouse's comet, at the lower pressures. Hydrocarbons are regarded as variable constituents of comets because the characteristic band at λ 431 is only an occasional feature of their spectra.

The anomalous spectrum of Brorsen's comet, as observed by the late Sir William Huggins in 1868, is explained by supposing that it resembled the "tail spectrum," the differences of wave-length not being beyond the probable limits of error. If this is the true explanation, it appears that the heads of comets vary considerably in density, that of Brorsen's being about the same density as the tail of Morehouse's.

A new high-pressure (100 mm.) spectrum of carbon monoxide was discovered during the research, and it is suggested that the presence of this in cometary spectra is indicated by the anomalous positions of the carbon bands observed. Thus the blue carbon band in cometary spectra often occurs at λ 468 instead of at λ 473, the position of the brightest head; the superposition of the brightest band of the new spectrum, at λ 4679, would account for this.

Some interesting deductions as to the nature and the illumination of comets' tails are made on the assumption that the actual conditions are comparable with those obtained in the laboratory experiments. For example, it is shown that to come within permissible limits of mass the tails must be hollow, or must be made up of attenuated sheets or streams. The illumination is probably of electrical origin, but whether the negatively charged particles producing it proceed from the head of the comet or from the sun is still an open question.

OBSERVATIONS OF SOUTHERN NEBULÆ.—The positions and brief descriptions of five southern nebulæ are published by Mr. Innes in No. 2 of the Transvaal Observatory Circulars. One of these objects, in R.A. 16h. 49m., dec. $-40°$ 36′ (1875), is very diffuse, and covers 10′ in declination and 3m. of R.A.: its position was determined from a plate taken with the Franklin Adams star camera. Cometary, planetary, and ring nebulæ are also included.

OBSERVATIONS OF THE AURORA.—In No. 3, vol. xxxi., of the *Astrophysical Journal* Prof. Barnard gives the details of all the observations of auroræ made by him during the period 1902–9. There are many points of interest too numerous to mention here, but it is evident that such carefully recorded data will prove extremely useful in discussing the probable relation of auroræ with solar outbursts, &c. Prof. Barnard outlines a scheme for systematic observations by observers some miles apart which would result in determinations of the height, &c., of specific auroræ. A tabulated statement of his results shows September and February to be months of prolific auroræ, but, as he points out, September is the month of clear skies, and the prominence of February depends largely upon the year 1907. July and December are especially low. There are indications of a maximum during 1907–8–9.

BRITISH SCIENCE GUILD.

FIRST ANNUAL BANQUET.

THE Right Hon. Lord Strathcona and Mount Royal presided at the first annual banquet of the British Science Guild, which was held at the Royal Institute of Painters in Water Colours, Piccadilly, W., on the evening of Friday, May 6. Amongst those present were the Right Hon. Lord Blyth, Col. Lord Kesteven, Sir Thomas Barlow, K.C.V.O., F.R.S., and Lady Barlow, Sir David Gill, K.C.B., F.R.S., Sir Norman Lockyer, K.C.B., F.R.S., and Lady Lockyer, Sir Alfred Keogh, K.C.B., and Lady Keogh, Sir Frederick Pollock, Bart., Sir William Ramsay, K.C.B., F.R.S., Sir Boverton Redwood and Lady Redwood, Sir Philip Watts, Sir Aston Webb, C.B., R.A., and Lady Webb, Sir William White, K.C.B., F.R.S., and Lady White, Colonel Sir John Young, C.V.O., Sir Henry Trueman Wood, Prof. Perry, F.R.S., Dr. W. N. Shaw, F.R.S., Prof. W. D. Halliburton, F.R.S., and Mrs. Halliburton, Mr. and Mrs. Carmichael Thomas, Mr. Roger W. Wallace, K.C., and Mrs. Wallace, Dr. A. D. Waller, F.R.S., and Mrs. Waller, Mr. A. Bruce Joy, Mr. Dugald Clerk, F.R.S., and Dr. F. Mollwo Perkin (honorary secretary).

After the Royal toasts, proposed by the chairman, "The Peace Organisation of the Empire" was proposed by Sir William Ramsay. He regarded it as a great honour to propose that toast—a toast given there for the first time. All he could do, perhaps, was to put before them some platitudes. He knew how little he knew, and he thought he knew a great deal when he had found that out. If he talked, therefore, in platitudes, he would be no striking exception to the rule. It was, he continued, generally supposed that science was something abstruse and abstract. It was not so. It was common sense, and common sense, as they all knew, was one of the rarest of commodities. What one learnt as one grew older was how little one knew about anything. How complex the simplest things were! His attention, he continued, had been turned to physical problems where the things he dealt with were comparatively simple. He had been working on the questions of liquids and gases—things more simple than social or economic problems; and yet those ideas, simple as they were, did not often find simple expression. He instanced the case of "the square of a temperature," which, like many other such phrases, conveyed no definite idea to anybody. If that was so in simple physical science, how much more complex were the problems that faced the social reformer. In this complex world of ours he (Sir William) had the utmost difficulty in making up his mind which of two political candidates was the one to vote for. He wished that Mr. Haldane, their president, had been there to illuminate that subject. It might even be desirable, continued Sir William, to get an elector like himself to vote against both candidates—to say that neither deserved his confidence; and if they could only get a sufficient number to vote like that, then no one at all would be returned to Parliament. Men of science, continued Sir William, had a uniform mode of procedure. They had a problem suggested to them which they thought worth investigating. They ascertained what had been done before on the subject, and then proceeded to try an experiment on a very small scale. The next stage was to try the experiment on a larger scale, and if that also promised well they might be encouraged to erect a large plant and increase it to the maximum of its production. Now, he asked, did they do that in politics? He thought not. The analogy was a close one. The problems which confronted the manufacturer were very much the same as the problem which confronted the Government. They both wanted to produce an article in demand. They had a permanent staff in both cases, and they wanted to provide an article that would meet with public approval. Men were constantly improving —at least if they were not progressing they were retrogressing, as it was impossible to stand still. In chemical manufacture what was chiefly wanted was—brains. A well-known manufacturer declared that brains were indigenous to Cambridge, and that he only wished he could get a number of Cambridge men to work on the lines he would suggest. That was exactly the Government's difficulty too. Mr. Haldane recently stated he had made the discovery that not only in Parliament, but in other

places, there were brains, and that there were persons who, if they would, could solve those complex problems which were so costly, and yet for which one had to find some immediate solution. Now the intelligent manufacturer—just as a Government does—provides himself with a permanent staff to keep things going; but, further than this, he brings in other people in order to consult with them if anything goes wrong, or if he has reasonable grounds for believing he can make an improvement. The person thus consulted receives a retainer, perhaps—gets so much a year and so much a job. "It is suggested," continued Sir William, "and I think it is an admirable notion, that the same plan which has proved itself successful in helping our manufacturers should be applied by the Government. There is an enormous number of people in this country who could be got by a very small retainer indeed, or perhaps feel honoured by being chosen, and when required they would be at hand to help with their advice."

The question of dirigible balloons threatened our naval supremacy, continued Sir William. What was the best way to destroy them? The natural way was to project a shell at them; but our mechanical art had not grown so perfect as to enable us to time the explosion of a shell to the thousandth part of a second, while, on the other hand, the substance of the balloon would be too soft to explode the shell by concussion on contact with the balloon itself. "I was asked," Sir William proceeded, "what was the best way to destroy those balloons, and I made several suggestions. I am perfectly willing to put any suggestions I have at the disposal of the Government for the benefit of my country, and I am sure there are hundreds of thousands in the same position who are able and willing to do something for the benefit of this country without pay." Concluding, Sir William said that the practical solution of that problem was that there should be consultative committees formed in all branches of inquiry appertaining to the national welfare, and he saw no reason even why such parties called in for consultation should not be paid just as the ordinary consultee was paid by the manufacturer when called in to tender advice. The appointment of a large number of such consultative bodies, call them what they wished, would be of inestimable advantage to the nation in solving many of the complex problems which were so baffling to the ordinary advisory resources of a Government dependent practically altogether upon its permanent staff.

Mr. Frederick Verney, M.P., responding in the absence of Sir William Mather, said it was most interesting to hear a man of science speaking on politics. He heartily agreed with Sir William Ramsay in his main contention that the Government would be immensely helped and rendered far more efficient if they had at their disposal and took advantage of the enormous amount of latent wisdom which only required to be called forth to be put at the service of the country. If England could boast of one thing more than any other nation, there was one thing which we might safely say, and that was that in no other country was so much and so good unpaid work done to-day as was done in England. It was not so desirable to increase that work as to render it more efficient for the Empire at large, and he did not believe any member of the House of Lords or House of Commons would be against that proposal. Certainly no one in England would have welcomed more warmly Sir William Ramsay's proposal than Mr. Haldane himself, as there was no statesman who had shown himself more eager to avail himself of all the science put at his disposal than the Secretary of State for War. In any case, if there was any consolation for people to be killed scientifically, they would have abundance of chance of it in due time, and in the next great war he was afraid they would have too much of it. There was one essential difference between politics and science. In politics they had nothing but uncertainties to deal with, but in science they had perhaps something tolerably certain to deal with. In politics one had to deal with human nature—with character—and thus the uncertainties of political life were the hardest to foresee and the most difficult to deal with; and the man who could fight his way through the uncertainties of politics, and could do something for the good of the nation at large, deserved well of his country, and merited the name of British statesman.

Sir Alfred Keogh, K.C.B., also responded to the toast. As to the application of science to methods of government, he was glad to hear allusion made to their distinguished president, who was the great exponent of that idea. Regarding the possibility of war with Germany, we were at present engaged in real warfare with her, but that war was being waged in the laboratories of the two countries. The German nation deserved scientifically all the admiration we could give to it. It had recognised the relation of science, not only to industries, but to methods of government and the general education of the community. The great disadvantages in this country were that our rulers and governors did not appear to be acquainted with the fact that they had at their elbow men who, over and over again, would help them in all the problems they had to solve.

Sir William White, K.C.B., F.R.S., in giving the toast "The Armed Forces of the Empire," said that that toast was not a novelty, but although he had known it by many titles, it always meant the same thing—namely, that, as British citizens, they desired to honour and remember those who gave or were ready to give their lives for the service of the country and of the empire. Behind "the armed forces of the empire," he reminded them, lay the principle of personal service, and whatever else we could give, there was one thing we could all give to our country and empire, and that was personal service. In modern times war was a very complex thing. The day had passed when personal courage alone and readiness to do or die were an assurance of victory, because nowadays so much depended upon the equipment of war, in the perfecting of which every branch almost of art and science was laid under tribute; but although the material was important, it required the man and mind to utilise it; and when the man and mind were employed in competition with others struggling for victory, it was in the highest degree important that those who served in our armed forces should be equipped mentally, scientifically, and in every way possible so as to give the fighting unit an honest chance. Those were matters, however, which depended upon the central administration, and if it was not conducted on scientific lines, then there was little hope of that object being fulfilled.

Col. Sir John Young, in responding, concurred with the proposer of the toast in regard to the importance of science to the efficiency of the naval and military forces. He was glad to say that in Mr. Haldane, at any rate, true scientific principles have had a friend who understood thoroughly the job he had to accomplish.

Sir Boverton Redwood proposed the toast of "The British Science Guild in Greater Britain." Some misconception, he said, existed still as to what the guild really was. Many people thought it was only an addition to previous learned societies. He reminded them that the British Science Guild was not a scientific society in the ordinary acceptation of the term, but was an organisation intended primarily to bring about the adoption of scientific methods in all matters of daily life, and incidentally to promote and foster the study of science by people who were not what might be called "scientific people." The term "science," however, frightened and repelled many, although it had been defined over and over again as the organised application of common sense. He cordially endorsed Sir William Ramsay's opinion that the attention given to that organised application of common sense was lamentably lacking in many quarters, from the Government downwards. Now, that state of things must not continue if the British nation was to hold its dominant position amongst the nations of the world. The British Science Guild had shown them already what ought to be done, and how to do it, and it was not only in this country that there was scope for its work. From its inception there had been a gradually increasing number of members in Greater Britain beyond the seas, and that was an exceptionally good feature of the movement. Already some action had been taken in the direction of organising those members, and branches or committees had been formed with that object in Canada and Australasia. The effect of that was to stimulate the interest they took in the guild and to bind them to the common body, and generally they had evidences that there was the opportunity for great benefit from the work of those branches in the empire beyond the seas.

The chairman, in responding, gave an interesting account

of the remarkable progress of Canada since the visit of the British Association in 1884. Lord Rayleigh had, in allusion to that visit, described Winnipeg as the only city he knew where they ploughed up their streets to make them level. To-day Winnipeg had streets as good as those in London, and was thoroughly equipped in up-to-date institutions and modern conveniences of every kind. It was perfectly useless, he continued, for the unemployable, who could not or would not work, to go to Canada. There they would be absolutely lost, because everyone in Canada was a worker, but they gladly welcomed the genuine and willing worker in Canada, which was really as much England as was the Mother-country.

Sir David Gill, K.C.B., F.R.S., also responded, and said that in dealing with science and its application to practical affairs, there was not the least doubt that the temperament of men of science had been somewhat of a drawback in forcing scientific facts and principles upon the attention of mankind generally, as the man of science was apt to think he had done all he could do when he had found out scientific truths. He seemed to require something to aid him in forcing upon unwilling Governments that information which they were too ignorant to apply to national needs.

"The Guests" was proposed by Sir Frederick Pollock, Bart., and responded to by Mr. Roger W. Wallace, K.C., after which Sir Aston Webb, C.B., R.A., gave the toast of "The Chairman," to which the latter gracefully responded, thus concluding the proceedings.

CLIMATOLOGICAL REPORTS.

THE director of Chemulpo Observatory (Dr. Y. Wada) has issued the mean annual results of the valuable meteorological observations made at the Japanese stations in Corea in 1906–7 (see NATURE, April 1, 1909). The following are some of the results of air-temperature and rainfall for 1907:—

Station.	Chemulpo	Fusan	Wonsan	Mokpo	Song-chin	Yongamp
Latitude, N. ...	37° 29′	35° 6′	39° 9′	34° 47′	40° 40′	39° 56′
Longitude, E. ...	125° 32′	129° 3′	127° 26′	126° 22′	129° 11′	124° 22′
Mean max.... ...	15·1°	17·5°	16·8°	17·7°	13·2°	13·4°
Absolute max. ...	34·6	32·5	37·5	32·7	32·0	32·9
Month	VIII	VIII	V	VIII	VI	VII
Mean min. ...	7·2	9·8	6·0	9·8	4·1	4·3
Absolute min. ...	−14·5	−8·4	−18·1	−8·2	−21·4	−24·3
Month	XII	II	II	II	II	XII
Adopted mean ...	10·8°	13·6°	10·3°	13·1°	8·2°	8·6°
Total Rainfall ...	667·3	1021·2	1576·5	811·6	627·3	1029·6

The instruments and method of observation are the same as those at meteorological stations in Japan; temperatures are given in centigrade degrees and rainfall in millimetres. The mean temperature was practically normal, but the rainfall fluctuated considerably; the data for the normals for these stations only go back to March, 1904.

The report of the Mauritius Observatory for 1908 shows that the mean annual temperature, 73·6°, was practically normal; the absolute maximum was 89·1°, minimum 53·8°, maximum in the sun's rays 166·2°, on November 12. The rainfall, 62·43 inches, was 14·5 inches above the average of 1875–1908, but for the whole of the island, obtained from reports from sixty-five stations, the mean was 90 inches, being $7\frac{3}{4}$ inches above the average. Six cyclones occurred over the South Indian Ocean; during one, between February 28 and March 4, very heavy rainfall occurred over the whole island, ranging from above 45 inches at Curepipe to 9 inches at Port Louis; the tracks of three of the cyclones have been determined. Ninety-four photographs of the sun were sent to the Solar Physics Committee, and particulars of fifty-four earthquakes were sent to the seismological committee of the British Association.

The report by Mr. Iyengar of meteorology in Mysore for 1908 embodies the daily and monthly means for the second-order stations at Bangalore and Mysore, and the 8h. a.m. observations, with their monthly means, at the third-class stations at Hassan and Chitaldrug. Over the province, as a whole, the temperature of the year was practically normal; April was the warmest, and December the coldest, month. The absolute maxima and minima were 102·1° at Chitaldrug (in May) and 50·1° at Hassan (in December). The rainfall was deficient and very unequally distributed, the defect varying from 13 to 43 per cent.; in November and December there was practically no rainfall.

The report issued by the Egyptian Survey Department on the rains of the Nile Basin and the Nile flood of 1908 states that during that year rainfall was measured at eighty-eight stations in the Nile Basin, while that recorded at 118 other stations in neighbouring regions was studied in connection with the meteorological conditions of north-eastern Africa. On the whole, rainfall was deficient to the south of the equator, and the country between the Victoria and Albert lakes seems also to have received less rain than usual. On the Bahr el Jebel the annual fall was usually in excess, and in the plains of the Blue Nile some months were wetter than usual. The tables show the monthly and annual rainfall for 1908, and the means for other years so far as data are available. We have previously referred to the flood of 1908, which again reached its normal value after a series of nine low floods. An interesting chapter on earth movements at Lake Victoria is added to the report.

The report of the chief of the U.S. Weather Bureau for the fiscal year ended June 30, 1908, shows that the important work of that department has been carried on with great activity. The tables, which extend over some 390 pages, include, *inter alia*, observations made twice daily during 1907 at twenty-nine stations selected to cover as nearly as possible all sections of the United States showing distinctive climatic features, monthly and annual summaries at 188 stations, and records of excessive rainfall in short periods at stations furnished with self-registering gauges. In our issue of October 21, 1909, we directed attention to several matters referred to in the administrative report, from an advance copy published in the annual summary of the *Monthly Weather Review* for 1908. We may add that this report states that the officials of the Bureau are encouraged in giving popular lectures with the view of eradicating superstitions prevailing with regard to the weather, and that instruments and charts are now exposed in kiosks at various suitable places. The instruments comprise special forms of maximum and minimum thermometers, air thermometer, hair hygrometer, thermograph, and a special type of rain-gauge with dial indicator.

The "Meteorological Year-book" of the Deutsche Seewarte for 1908, which has recently been published, contains the results of observations at ten stations of the second order, hourly observations at Hamburg, Wustrow, Memel, and Borkum, and storm statistics at fifty-seven signal stations in the North Sea and Baltic whenever a gale was experienced over a considerable area, embracing not fewer than three of the stations. The appendices include the hourly means of wind velocity at Pillau (a seaport in eastern Prussia) for the period 1899–1908. The mean monthly values exhibit a minimum in July (4·09 m.p.s.), rising gradually to a maximum (6·29 m.p.s.) in December, and gradually decreasing again to the minimum.

From an excerpt from the "Bavarian Meteorological Year-book" for 1909 we learn that registering balloon ascents made at Munich in connection with the international scheme for the investigation of the upper air were not so successful as in some previous years, owing to unfavourable weather conditions and loss of the instruments used. Nevertheless, eighteen successful ascents were made, and the results have been very carefully discussed. Among the several interesting features shown by a preliminary summary of the results for the years 1906–9 we may refer to the mean altitude and temperature at the beginning of the upper inversion, arranged according to seasons, which were found to be as follows:—winter, 10,650 metres, −61·5° C.; spring, 9870 m., −54·9°; summer, 11,770 m., −57·2°; autumn, 11,790 m., −58·2°. The mean monthly tables show that the lowest altitude of the "stratosphere" was in March and the highest in August. An extraordinary increase in altitude, practically without change of temperature, occurs from April to May, viz. from 9470 to 11,050 metres: but owing to the few and unequal number of cases available, the results deduced can only be accepted with caution.

The first part of a series of valuable contributions to the

climatology of South Germany appears in the "Bavarian Meteorological Year-book" for 1909, viz. investigations by MM. E. Alt and L. Weickmann on thunderstorms and hail, from observations made in Bavaria, Württemberg, and Baden during 1893–1907 at carefully selected stations. The discussion is carried out in great detail, with tables for geographical districts, isopleths for thunderstorm frequency in W.-E. and N.-S. directions, and by charts, but we can only refer to some of the more general results. The mean daily period of thunderstorm frequency for the whole of South Germany shows that the principal maximum occurs between 2h. and 5h. p.m., 39 per cent. of storms taking place about 3h. p.m. In the annual period the storms occur most frequently between April and September, the maxima being in June and July. With regard to hailstorm frequency, 70 per cent. of the storms occur between noon and 6h. p.m., the maxima being from 3h. to 5h. p.m. In the yearly period they occur most frequently between May and July, the maximum being in June, and, compared with the number of thunderstorms, hailstorms were comparatively rare. It may be mentioned that investigations as to a possible connection of thunderstorm frequency with the sun-spot period led to no result.

The results of the meteorological and magnetical observations for 1909 at Stonyhurst College Observatory, Lancashire, have been received. The tables are, as usual, plainly arranged, and the departures from very long averages being given render the data exceedingly valuable. The weather of the year was generally mild and quiet; the temperature of June was 3·2° below the average, and July and December were very wet, each having more than 4 inches above the average rainfall. The mean of the highest daily temperatures was 52·1°, of the lowest 40·6°; adopted yearly mean, 46·2° (0·6° below the average for the last sixty-two years). The highest reading was 75·1° (August 15), the lowest 15·1° (December 21). The total rainfall was 48·77 inches (1·84 inches above the normal). The mean disc area of sun-spots (in units of 1/5000th of the visible surface) appears at 3·8, and the mean daily range of magnetic declination at 13·5′; the mean for the year was 17° 28·5′ W. Photographic copies of noteworthy seismographs were supplied to various authorities, and would be sent to any observing station on application.

THE PROGRESS OF AGRICULTURE IN INDIA.[1]

IT would be difficult to conceive a harder task than that set before the members of the staff of the Agricultural Department of India when they first set to work to improve Indian agriculture. The native methods of working were often primitive, their seeds were impure and their crops uncertain; the ryots were uneducated, poor, and without that ambition to rise that would have gone so far to lighten the work of the newcomers; but, in spite of all this, the Department has, in the space of a comparatively few years, done a vast amount of work; it has to chronicle failures as well as successes, but the successes have largely preponderated, and we can see some of the results in the various reports that have recently been issued.

The research institute for the Indian Empire is at Pusa, an estate of more than 1300 acres bounded on three sides by a loop of the little Gundak River. It is situated in the heart of a district where intensive cultivation prevails in consequence of the favourable climatic and soil conditions, which are also indicated by the density of the population—900 to 1100 per square mile. As, moreover, the district is largely controlled by a community of indigo planters, there is little fear that cultural improvements suggested by the staff should be unnoticed. The Phipps laboratory is said to be admirably suited for its purpose; it is provided with water-power and electricity, while the soil of the experimental grounds can be made to grow practically all the important crops of the plains. The scientific staff comprises an agriculturist, a botanist, a chemist, two entomologists and a mycologist, with their supernumeraries and assistants.

In the botanical department Mr. Howard's work on wheat promises results of considerable importance both to India and to Great Britain. He has completed the classification of the Punjab wheats and has isolated some twenty-five pure types, the best of which will in time be available for general distribution. A survey on similar lines of the varieties grown in the Central Provinces, Bengal, Bombay, the United Provinces and Burma is in hand. This work is being followed by hybridisation to evolve new varieties possessing strength of straw, good cropping power, and resistance to rust. Some of the pure types which are being used as parents were found to be a great improvement on the mixed sorts previously grown, and we are not surprised to read that "large numbers of colonists came to see the plots and arranged for small supplies of seed for trial on their holdings." Not only is there the likelihood of an increased yield, but it appears that India can grow "strong" wheats such as are required in the English market, the common impression that Indian wheats are necessarily weak being erroneous. The economic results of a notable increase in wheat production of high quality can hardly be overestimated. An interesting physiological problem is also under investigation. It was found in 1908 that the same sample of Muzaffernaggar wheat sown at Lyallpur, Muzaffernaggar and Pusa gave rise to grain varying markedly in appearance, composition, milling and baking qualities. Mr. Shutt has observed similar variations in Canada. The cause can hardly lie in the amount of plant food in the soil, since no such variation is observed in going from plot to plot on the Broadbolk wheat field at Rothamsted; it must lie in some other of the factors constituting the general environment. Further investigations will be awaited with much interest.

Dr. Butler has continued the mycological work on the lines of previous years, very wisely concentrating attention on a few diseases, and carefully working out the life-history and general biology of the organisms involved. Of these, the chief are "red rot" in sugar-cane, the palm diseases, the wilt diseases of various crops, "white rust" and other diseases of citrus, the mulberry disease of Kashmir, and others. So successful has Dr. Butler been in combating the palm disease in the Godavari delta that he is considered on this work alone to have paid the cost of his department for many years to come! He has in preparation a book on Indian plant diseases that may be expected to help Indian planters considerably.

Dr. Leather was away on leave for part of the time, his place being taken by Mr. Annett. Work was continued on the losses of water from the soil, and the water requirements of plants, subjects that are obviously of fundamental importance in India. It was found also, in the first instance by pot experiments, and later by field trials, that certain soils benefitted notably by manuring with phosphates.

The task of controlling the insect pests falls to the lot of Mr. Maxwell-Lefroy, the Imperial entomologist, and Mr. Mason, with assistants for special work, but the staff is small for the work it has to do. The life-histories and habits of a number of injurious insects have been investigated, and also the influence of climatic changes on insect life and the problem of utilising beneficial insects. Attention has been devoted to seri-culture and to lac. The second entomologist, Mr. Howlett, investigates Diptera. He has ascertained the life-histories of nearly all the mosquitoes occurring at Pusa, and has, in addition, found two species of fish capable of destroying large numbers of Anopheles larvæ. The number of Diptera injurious to crops and animals is very considerable, and fully justifies the appointment of an entomologist to deal especially with them.

The improvement of the livestock and poultry of India is undertaken by the Agricultural Department under the direction of Mr. Shearer. A large and remunerative export trade in Indian cattle has recently arisen, for which the Montgomery appears especially suitable. Careful attention is therefore being devoted to this breed.

Such is a brief outline of the main lines of work at

[1] Report on the Progress of Agriculture in India for 1907–9. (Calcutta: Superintendent Government Printing, India.)
Report on the Introduction of Improvements into Indian Agriculture by the Work of the Agricultural Departments.
Report of the Agricultural Research Institute and College, Pusa, 1907–9.
Agricultural Statistics of India for the Years 1903–4 to 1907–8. 2 vols.
Report on the Operations of the Department of Agriculture, Madras Presidency, for the Official Year 1908–9.
Madras Agricultural Calendar, 1910.

Pusa. The various provinces have also agricultural departments, with scientific staffs investigating problems of local importance and methods suitable for their own districts; an example of the kind of work they do is afforded by a study of the Madras report. The methods of bringing the scientific work to the notice of the cultivators were discussed by a committee of the Board of Agriculture and collected in their report—the second on our list. Whilst they vary somewhat in the different provinces, they may be classed roughly as (1) agricultural associations; (2) local demonstrations; (3) village agencies which hire out improved implements and demonstrate their use; (4) vernacular journals controlled by the Department, those run by private enterprise not being always satisfactory; (5) leaflets, circulars, and *communiques* to the Press; (6) shows; (7) itinerant assistants, who, under suitable conditions and when working on one definite problem, have been found of considerable service; (8) seed farms and depots to do the work which seed merchants do here; (9) schools to train the sons of cultivators; (10) colonisation with expert cultivators. Like the cultivator of the soil in all countries, the ryot is conservative but not unwilling to take up a new thing that is clearly going to be of advantage; he suffers, however, sorely from lack of funds, and we are told that he often has to pay so much as 24 per cent. interest or more per annum for the money which he must borrow if he is to effect improvements. He must therefore get more than 24 per cent. return or he loses on the transaction, and so it may happen that an improvement which would be profitable elsewhere is of no advantage to him. This state of affairs can only slowly be remedied, and must for long remain a bar to the general improvement of Indian agriculture.

But when we turn to the large cultivators there is no such hindrance, and it may reasonably be expected that they will gain considerable benefit from the scientific work that is being done. To give only one instance, Mr. Bergtheil is investigating the problems of the indigo planters, and has already obtained results of value, a number of improvements having been effected of notable aggregate value. It has been shown, further, that the yield per acre can be increased very considerably by substituting the Java for the more common Sumatrana variety. By selection and hybridisation it may be possible to get even better results. The belief is expressed in the report that the natural indigo will yet compete successfully with the synthetic product.

Such large works as irrigation are outside the scope of the present reports, although of great importance to the advancement of agriculture. Work is, however, in hand on the reclamation of *reh* or alkali land, a condition that may accompany irrigation unless drainage is also attended to. Mr. Henderson is making satisfactory progress in reclaiming the very salt soils of Sind. Other important improvements are going on, and we may in the near future look for great returns for the work that is now being done.

E. J. R.

THE MESSINA EARTHQUAKE AND ITS PREDECESSORS.

ITALIAN Government Commissions have recently issued two valuable reports on the earthquakes of Calabria and Messina. One of them deals with the earthquake of November 16, 1894, a shock of great interest, but overshadowed by the disasters of 1905 and 1908. The greater part of this report, of 350 quarto pages, consists of a detailed account of the earthquake by Prof. A. Riccò. Sig. E. Camerana considers the nature and distribution of the damage to property, and suggests methods of construction that should be employed in future; Dr. M. Baratta investigates the relations of the earthquake with its predecessors; and Dr. G. di-Stefano describes the geological structure of the district. The epicentral area includes the villages of San Procopio, Santa Eufemia, and Seminara, which lie near the west coast of Calabria and about twenty miles from Messina and Reggio. The number of persons killed at these and other places was 101, and the number of wounded about a thousand, the highest death-rate, of about 5 per cent., occurring at San Procopio. The epicentre coincides nearly with that of the well-known Calabrian earthquake of February 5, 1783. The isoseismal lines of the two earthquakes were similar in form, both being flattened and compressed towards the east, and expanding in the opposite direction. The earthquake of 1783 was, however, much the stronger, the loss of life far greater (the death-rate at one place rising to 75 per cent.), and the after-shocks were five times as numerous as in 1894, were of greater intensity, and were spread over a longer interval of time. The earthquake of 1894 was, in fact, a replica, on a much smaller scale, of the greatest of all Calabrian earthquakes.

The Messina earthquake of 1908 is of far greater interest and importance than its predecessor of 1894, and it is satisfactory to find that the reports on it are being issued without undue loss of time. A Royal Commission, under the presidency of Prof. Blaserna, was appointed to investigate the sites best adapted for the re-building of the ruined towns. The report of the commission is of more than local value. As regards Messina, while recognising the unsatisfactory nature of the subsoil, it is realised that, for commercial and other reasons, the city must be re-built on its former site. It is recommended, however, that the building regulations adopted for districts of high seismicity should be rigorously enforced, and that no buildings intended as permanent dwellings should be erected on loose sands and gravels on sloping ground or within a hundred metres of the sea, and the commission also points out certain suburban districts in which the city might be allowed to expand.

Two or three of the appendices to the report are of considerable interest. In one, Sig. P. Marzolo, director of the Hydrographic Institute, compares the results of the soundings recently made in the Straits of Messina with those made in 1876–7. There are, he finds, no abrupt changes of level, but outside the Straits, to the north, the bathymetric curves of 200 and 300 metres are now much farther from both the Sicilian and Calabrian shores than they were in 1877, while the curve of 400 metres near the Calabrian coast no longer exists. Sig. Marzolo, however, refers the change to deposits from ocean currents rather than to elevation of the sea-bed. In the harbour of Messina, the bathymetric curves for the years 1903 and 1909 are practically coincident, and this is also nearly the case with the curves for 1908 and 1909 for the harbour of Reggio.

In another appendix Sig. A. Loperfido describes the results of new series of levellings, former series having been made along the same lines in 1907–8. In each case the new levellings were begun at points so distant that their altitude may be regarded as unchanged by the earthquake. In Calabria they started at Gioia Tauro (9 km. north of Palmi), and were continued round the south coast over a length of 87 km. The changes of level, at first inconspicuous, begin to exceed a tenth of a metre at Favazzina, and from this place to Saline they indicate a continuous lowering of the coast, amounting to 42 cm. at Villa S. Giovanni and 54 cm. at Reggio, with a maximum of 58 cm. about a kilometre south of Reggio. In Sicily three shorter lines of levelling were carried out, one from Capo Peloro to Messina, and the others inland from the latter city. They show a lowering of 65 cm. at the mareograph of Messina, a maximum of 71 cm. being attained about 3 kilometres farther north.

A paper by Sig. F. Eredia on Messinese earthquakes has appeared in the *Bollettino* of the Italian Seismological Society (vol. xiii., pp. 481–96). In this he describes a series of earthquakes which occurred in August, 1898, the centres of which were near Rometta, which lies seven miles south-west of Messina. Two of these shocks (on August 6 and 12) were strong enough to cause slight damage to buildings at Rometta, and before the end of the month they were followed by at least eighty slighter tremors. The centres of both shocks were beneath the Peloritan mountains. Comparing the areas most strongly shaken by them with others disturbed in April, 1893, and February, 1904, it would seem that, during the eleven years, there has been a continual northerly migration of the epicentres.

C. D.

MAGNETIC STORMS.[1]

THE magnetic needle has been described with poetic licence as "true to the pole," and few, I suspect, are aware how little it deserves this reputation. The earliest known information on this point in England dates from 1580, when Boroughs, observing at Limehouse, found the needle to point $11\frac{1}{4}°$ to the east of geographical north. During the next $2\frac{1}{3}$ centuries it kept moving to the west, reaching its extreme position of $24\frac{1}{2}°$ to west of north in 1818. It has since retraced its path, and now at Kew points only a little more than 16° to west of north.

Besides this slow secular change, there are daily changes, which are continuously recorded at a number of observatories. At a complete station there are three magnetographs, recording, respectively, declination, horizontal force, and vertical force changes. In the Kew pattern instrument each magnetograph has a separate drum and a separate sheet of paper, but the three drums are driven by a single clock, and two days' traces are usually taken on the same sheet.

In some foreign types of magnetograph, *e.g.* the Eschenhagen, which was used in the National Antarctic Expedition of 1901–4, the three elements are recorded on one drum, but only one day's record is taken on each sheet.

In my subsequent remarks I am obliged to employ a term having more than one meaning. It will be simplest to explain these by reference to the familiar daily variations of temperature. Suppose that in March we record the temperature at Kew at every hour and take a mean value for each hour of the twenty-four from all days of the month. We shall then find a regular rise from a minimum, probably at 6 a.m., to a maximum, probably at 3 p.m., and then a gradual fall to the minimum. The difference between this maximum and minimum is known as the *range* of the regular diurnal inequality for the month. On individual days, however, the hours at which the highest and lowest temperatures occur will vary, and if we take the mean of the differences between the highest and lowest temperatures of each individual day, irrespective of the hour at which they occur, we get a totally distinct range, which I shall call the mean *absolute* range.

The absolute range in any element cannot be less, and must usually be considerably greater, than the range of the regular diurnal inequality. At Kew, for instance, the mean absolute daily range of declination derived from the eleven years 1890 to 1900 was 13·6′, while the corresponding range of the regular diurnal inequality was only 8·0′.

The range of the regular diurnal inequality varies with the season of the year. Table I. shows its amplitude in the case of the declination at Kew, Batavia, and the *Discovery's* winter quarters.

TABLE I.

Range of Regular Diurnal Inequality (Declination).

Station	Lat.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	° ′	′	′	′	′	′	′	′	′	′	′	′	′	′
Kew ...	51 28 N	4·9	6·1	9·1	10·9	10·7	10·9	10·6	**11·0**	9·5	7·7	5·4	**4·5**	8·0
Batavia..	6 11 S	4·2	**4·6**	3·6	2·9	2·4	**2·0**	2·3	3·2	3·8	4·5	4·5	4·2	3·0
Antarctic	77 51 S	58·6	69·6	47·4	35·4	**27·3**	28·1	29·2	35·8	52·6	45·5	60·1	**85·2**	45·5

Remembering that in the southern hemisphere June represents mid-winter, it will be seen that the range is in all cases larger in summer than in winter.

Allowance must be made for the fact that the disturbing force required to displace the needle 1′ out of the magnetic meridian is proportional to the horizontal component H of the local magnetic force. Now the values of H in C.G.S. measure, at the epochs to which the data refer, were 0·183 at Kew, 0·367 at Batavia, and only 0·065 at the Antarctic station. Thus the disturbing force required to produce a range of 1′ at Batavia would produce a range of 2′ at Kew and of nearly 6′ at the *Discovery's* winter quarters; but, even allowing for this, the Antarctic range is much the largest of the three.

[1] From a discourse delivered at the Royal Institution on Friday, March 4, by Dr. C. Chree, F.R.S., Superintendent Observatory Department, National Physical Laboratory.

The great increase apparent as we pass from temperate to Arctic or Antarctic latitudes is even more conspicuous in the irregular movements, which, when sufficiently pronounced, are known as magnetic storms. This is illustrated by Table II.

TABLE II.

Absolute Ranges of Declination.

At Kew from 11 years				Antarctic (77° 51′ S.) from 2 years			
Percentage of Days when Range				Percentage of Days when Range			
0′–10′	10′–20′	20′–40′	over 40′	0′–30′	30′–60′	60′–120′	over 120′
31	57	11	1	7	22	32	39

As already explained, the forces required to displace the needle 1′ out of the magnetic meridian at Kew and 3′ out of the magnetic meridian at the Antarctic station are approximately equal. If, then, the disturbing forces at the two places were of similar magnitude, we should expect ranges of less than 30′ in the Antarctic to be as common as ranges of less than 10′ at Kew, and ranges above 40′ at Kew to be as common as ranges above 120′ in the Antarctic. This, it will be seen, is exceedingly wide of the mark. A single year's records in the Arctic or Antarctic is likely to supply as many large disturbances as the records of a generation in the south of England. This is one reason why so much importance attaches to continuous magnetic observations in high latitudes.

The daily amplitude of irregular magnetic changes, like that of the regular diurnal inequality, is variable throughout the year, but the seasonal variation is usually different in the two cases. This is shown by Table III.

TABLE III.

Annual Variation in Inequality and Absolute Declination Ranges at Kew, omitting Highly Disturbed Days (1890–1900).

	Winter	Equinox	Summer
	′	′	′
Inequality range	5·25	9·30	10·80
Absolute range	10·35	13·81	13·56

Each of the three seasons contains four months, March, April, September, and October being included under "Equinox."

If the days of large disturbance, averaging nineteen a year, had been included in Table III., the preeminence of the equinoctial value of the absolute range would have been greater. Kew, it should be added, is fairly representative of all stations in temperate latitudes.

When we pass to days of large disturbance, the prominence of the equinoctial season in temperate latitudes becomes accentuated. This is shown by Table IV., which gives the seasonal distribution of the 721 magnetic storms recorded at Greenwich from 1848 to 1903, as calculated from the lists drawn up by Mr. W. Ellis and Mr. E. W. Maunder, with corresponding results for Batavia from 1883 to 1899, obtained by Dr. Van Bemmelen.

TABLE IV.

Seasonal Distribution of Magnetic Storms.

Place	Epoch	Percentage of all Recorded		
		Winter	Equinox	Summer
Greenwich	1848–1903	32	42	26
Batavia	1883–1899	33	35	32

Out of every 100 storms recorded at Greenwich, forty-two occurred in the four equinoctial months.

The seasonal variation seems to diminish as we approach the magnetic equator, and but little remains of it at Batavia.

When we pass to high latitudes the preeminence of the equinox as a season for magnetic storms seems to disappear entirely. This is shown by Table V., which compares declination results at Kew and at the *Discovery's* winter quarters.

TABLE V.

Percentage of Days having Range above 20′ at Kew, and above 120′ at the "Discovery's" Winter Quarters (77° 51′ S.).

Station	Mid-Winter	Equinox	Midsummer
Kew	12	16	9
77° 51′ S.	24	31	81

At Kew, out of every 100 days at midsummer (May to July), only nine had an absolute range above 20′, the corresponding figure for the four equinoctial months being sixteen, or nearly double; but in the Antarctic eighty-one out of every 100 days at midsummer had a range exceeding 120′, while the corresponding figure for the equinoctial months was only thirty-one.

The phenomena of magnetic storms appear, at least at some stations, to be largely influenced by the hour of the day. Table VI. gives some figures for Greenwich derived from the hours of beginning and ending in Mr. Maunder's lists for the years 1848 to 1903, as well as some figures which Dr. Van Bemmelen has given for Batavia.

TABLE VI.

Diurnal Variation in Magnetic Storms.

Station	Local time	Percentage of Total Occurrences		
		1–8 p.m.	9 p.m.–4 a.m	5 a.m.–noon
Greenwich ...	Beginning	60	22	18
	End...	9	45	46
Batavia ...	Beginning	30	25	45
	End	18	55	27
	Maximum intensity	33	43	24

At Greenwich no less than 60 per cent. of the storms commenced during the eight hours 1 to 8 p.m., while only 9 per cent. then ended.

There is yet another influence on magnetic changes which requires to be considered, viz. sun-spots.

TABLE VII.

Connection between Sun-spot Frequency and Declination Ranges.

Year	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900
Sun-spot frequency (Wolfer)	7·1	35·6	73·0	**84·9**	78·0	64·0	41·8	26·2	26·7	12·1	5·5
Diurnal inequality range—											
At Kew	7′·3	8′·5	9′·8	**10′·7**	9′·8	9′·5	8′·5	7′·8	7′·6	7′·3	6′·8
At Pavlovsk ...	6·3	7·3	8·7	**9·6**	8·6	8·2	7·4	6·8	6·3	6·0	6·2
Absolute daily range—											
At Kew	10·7	13·7	**17·7**	15·6	16·5	15·6	14·5	12·1	12·3	11·3	9·2
At Pavlovsk ...	12·1	16·0	**21·0**	17·8	20·4	18·1	17·5	14·6	14·7	13·1	10·5
At Pavlovsk—											
Mean range in month	28·2	46·3	**93·6**	48·3	84·1	47·4	52·4	43·8	46·6	38·3	32·8
Total range in year	42·1	92·3	**194·0**	87·1	145·6	73·9	88·7	101·1	118·9	63·8	94·2

While Prof. Wolfer's figures are given in Table VII. as a measure of sun-spot activity, it may be added that closely parallel results would be derived from the Astronomer Royal's figures for sun-spot areas. There was a well-marked maximum in 1893. The remarkable parallelism between the changes in sun-spot frequency and in the diurnal inequality ranges appeals to the eye.

Passing to the absolute daily range, we have a quantity which is considerably influenced by magnetic storms. Here, again, the ranges in the years of many sun-spots are conspicuously the larger, but the parallelism with sun-spot frequencies is less close. 1893, the year of sun-spot maximum, shows at both Kew and Pavlovsk a distinctly smaller absolute range than either of the adjacent years, especially 1892. Of the last two lines in Table VII., the first gives the arithmetic mean of the differences observed at Pavlovsk between the extreme positions of the compass needle during each month of the year, while the second gives its total range during the year. In both cases 1892 occupies the premier, and 1894 the second, position. 1893 lags far behind; in the case of the annual range it even follows 1900, which had the smallest sun-spot frequency of the whole eleven years. The close parallelism visible between sun-spot frequency and the regular diurnal inequality becomes more and more obliterated as we pass from the regular to the less regular, and from these to the highly irregular daily changes of terrestrial magnetism.

A general parallelism between sun-spot frequency and the range of the regular diurnal inequality is far from proving any intimate connection between the two phenomena on the same day. Table VIII. gives the results of an attempt to find out whether the parallelism extends to individual days' results.

TABLE VIII.

Relation of Sun-spot Area (Greenwich) to Absolute Declination Range (Kew) on same Day and on Three Subsequent Days.

	Algebraic excess of range over mean from all days							
	10 days (each month) of largest spot area				10 days (each month) of least spot area			
	Same day	1 day after	2 days after	3 days after	Same day	1 day after	2 days after	3 days after
11-year mean	+0′·17	+0′·25	+0′·48	+0′·53	−0′·32	−0′·45	−0′·38	−0′·35
1894	+1·23	+1·55	+1·61	+1·69	−1·44	−1·92	−1·62	−1·36
1895	−0·85	−0·22	+0·c6	−0·17	+1·19	+1·41	+1·29	+0·92

The days of each month were divided into three groups. The first group included the ten days in which the Greenwich sun-spot areas were the largest, the third group the ten days in which they were least. If any close parallelism existed between the solar and magnetic phenomena on the same day, we should expect the mean of the absolute declination ranges from the first group of days to be much larger than the mean for the whole month, and that from the third group to be much less. Taking all the months of the years 1890–1900, there is a difference in the direction indicated, but it is exceedingly small.

To provide for the possibility that the solar influence takes one or more days to travel to the earth, mean declination ranges were formed, not merely for the ten days of largest or smallest sun-spot area, but also for the ten days immediately following these, for the ten days separated by two days, and yet again for the ten days separated by three days, from the days constituting the sun-spot groups. The results appear in Table VIII., and are somewhat more favourable for an association between the magnetic phenomena and the solar phenomena two or three days previously than for an association between the phenomena on the same day. Individual years, however, *e.g.* 1894 and 1895, give conflicting results.

In the preceding discussion declination has been chiefly referred to, because it is the most familiar element. In some respects, however, declination records during magnetic storms are inferior in interest to those of horizontal force. Fig. 1 shows two successive days' records—November 12–14, 1894—of this element at Kew. The first day's trace, which was quiet, helps to bring out two important features. A little after 2 p.m. on November 13 there is a very small decrease of force (downward movement), followed by a much larger increase. These sudden commencements to storms are not unusual, and seem to occur simultaneously all over the earth. The type at most stations is very similar. The initial slight fall in force is only sometimes seen; the rise is generally substantial. In the Antarctic the oscillatory character is unusually prominent.

By 8 or 10 a.m. of November 14 the disturbance is

practically over, but the force shows a marked depression compared to its value at the same time on the previous day. This is a very common after-effect of magnetic storms; the greater part of the depression usually disappears in two or three days. Fig. 1 is a good example of an ordinary disturbance in which the magnetic changes, though considerable, were seldom rapid. It differs conspicuously in this respect from the recent great storm of September 25, 1909. Many of the movements on this occasion were too rapid to be shown clearly in the photographic traces.

Dr. Schmidt, the leading German authority on our subject, assigns to this recent storm the first place of all recorded since the Potsdam Observatory came into existence some twenty years ago. Table IX. gives his estimate, on an arbitrary scale, of the intensity of the seven largest storms recorded at Potsdam.

Table IX.

Dr. Ad. Schmidt's Estimate of Intensity of Magnetic Storms.

Date of Storm	Disturbance at Potsdam	Date of Storm	Disturbance at Potsdam
September 25, 1909 ...	3800	September 11, 1908...	1520
October 31, 1903 ...	2860	August 20, 1894 ...	1410
February 14, 1892 ...	over 1800	February 9, 1907 ...	1340
July 20, 1894	1580		

An old question which has received a good deal of recent attention is whether there is a cyclic period approaching a month in the occurrence of magnetic storms. J. A. Broun, an early pioneer of magnetic work, believed his observations to indicate a period of about twenty-six days. From an elaborate study of many years' storms at Greenwich, Mr. E. W. Maunder deduced a period of 27·275 days, and Mr. Arthur Harvey independently, from a study of storms at Toronto, deduced the remarkably similar period of 27·246 days. The latest result of this kind is due to the eminent German magnetician already mentioned, Dr. Schmidt, who believes in a period of 29·97 days. Schmidt found evidence of this period in a number of recent storms, and he declares that it exists in the case of very large storms even when separated by many years. He found that the dates of occurrence of five out of the seven largest storms recorded at Potsdam (see Table IX.) could be deduced to a high degree of accuracy from the expression $2410{,}000+3031{\cdot}0+n\times 29{\cdot}97$, which counts time in days from the commencement of the Julian era.

Fig. 2, which serves as a chronicle of magnetic history at Kew from August 20 to November 16, 1909, will illustrate some of the difficulties in the way when one attempts either to prove or disprove the existence of a period in magnetic storms.

The upper curve shows the value each day of the absolute declination range at Kew, the lower the value at each midnight of the horizontal force. We see incessant variations from day to day, and the number of days in which the declination range conspicuously overtops the average is considerable. During these days there is usually a distinct fall in the horizontal force, a circumstance also indicative of magnetic disturbance. The following days were considerably disturbed:—August 29, 30, September 21, 25, 30, and October 18, 19, 23, 24; while a variety of other days, *e.g.* August 31 and October 2, 8, and 9, were decidedly more disturbed than the average. If we associate August 30 and September 25 we get a twenty-six-day period; if we associate August 29 and September 25, or September 21 and October 18, we get a twenty-seven-day period; if we associate August 31 and September 30 we get a thirty-day period; and we have any number of other possible combinations left. Disturbed conditions are seldom limited to a few hours of a particular day, and often extend over two or more days. Thus there is usually a good deal that is arbitrary in the value deduced by observation for the interval between two specified storms.

The disturbances of September 21, 25, and 30 led to a fall in the horizontal force, from which it is doubtful whether the element had entirely recovered even by the middle of November.

Mr. Maunder and Dr. Schmidt both associate their periods with that of the revolution of the sun relative to a point on the earth. This period exceeds the true period of the sun's rotation—which varies considerably with solar latitude—because the earth is travelling round the sun in the direction in which the sun rotates.

The view most in favour at the present time is that magnetic storms are due to some solar discharge, probably from sun-spot areas, and of an electrical nature. We may suppose a solar discharge to traverse space like a jet of water; when it overtakes the earth a magnetic storm begins, which continues until the full width of the jet has passed over. If the solar discharge continues long enough, it may sweep over the earth during several successive revolutions of the sun, and so give rise to a series of magnetic storms at nearly equal intervals.

Theories accepting a solar origin for magnetic storms differ as to the nature of the solar discharge.

Nordmann has suggested Röntgen rays, Birkeland kathode rays, and Arrhenius negatively charged particles. On Nordmann's hypothesis the terrestrial phenomena should follow the solar in a few minutes, on Birkeland's hypothesis in a few hours, while according to Arrhenius the interval might be two days or more.

The most elaborate investigation hitherto made into the supposed solar origin of magnetic storms is due to Prof. Kr. Birkeland, of Christiania, who believes kathode or analogous rays to be the vehicle by which the solar disturbance is propagated to the earth. He has made numerous experiments with kathode rays in a vacuum tube which contains a miniature earth or "terrella." By means of electric currents in wires wound on the terrella, a magnetic field is produced similar in type to the earth's field. It was apparently his experiments that suggested his explanation of a certain type of magnetic storm which he terms the "equatorial." These "equatorial" disturbances are,

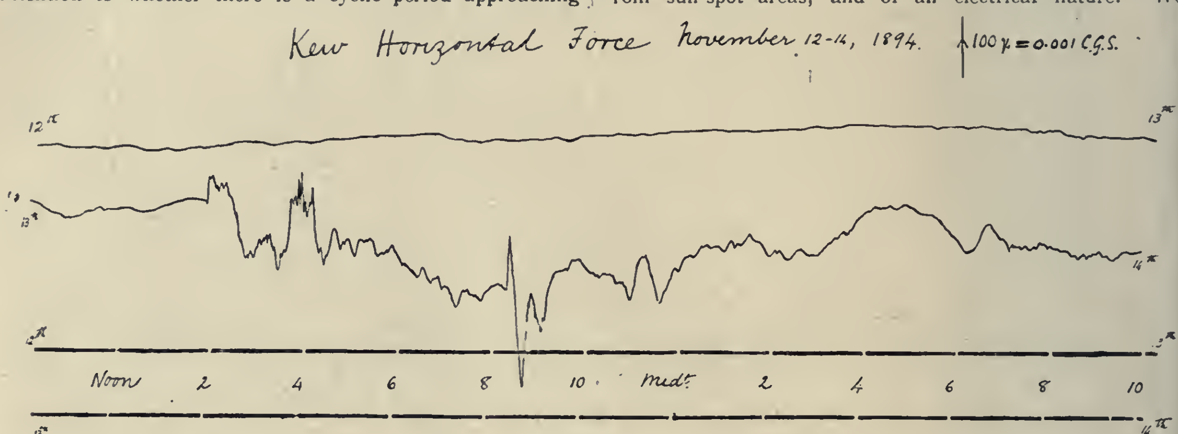


Fig. 1.

he says, normally largest in the earth's equatorial regions, where they consist mainly of a change in the horizontal force, but they are also well marked in temperate latitudes. The cause postulated by Birkeland is a circular electric current in the plane of the earth's magnetic equator, at a height of several thousand miles. An objection to this explanation is that, according to Prof. Carl Störmer's[1] analysis, it is impossible for kathode rays emanating from the sun to reach the earth's atmosphere at all, except in a narrow band round each magnetic pole. The larger the mass and the greater the velocity of the particle for a given electrical charge, the nearer can it approach the earth in the equatorial plane, and the larger is the radius of the zone surrounding each magnetic pole within which the particle can actually reach the earth. The β particles of radium, from their higher velocity, have more penetrating power than ordinary kathode rays, and are, in their turn, eclipsed by the α rays, the lesser velocity of which is more than compensated by their larger mass. According to Störmer, the greatest angular distance from a magnetic pole at which average kathode rays emanating from the sun can reach the earth is only 4·1° and 12·7°, while the corresponding angular distances for β and α rays are respectively 4·1° and 12·7°.

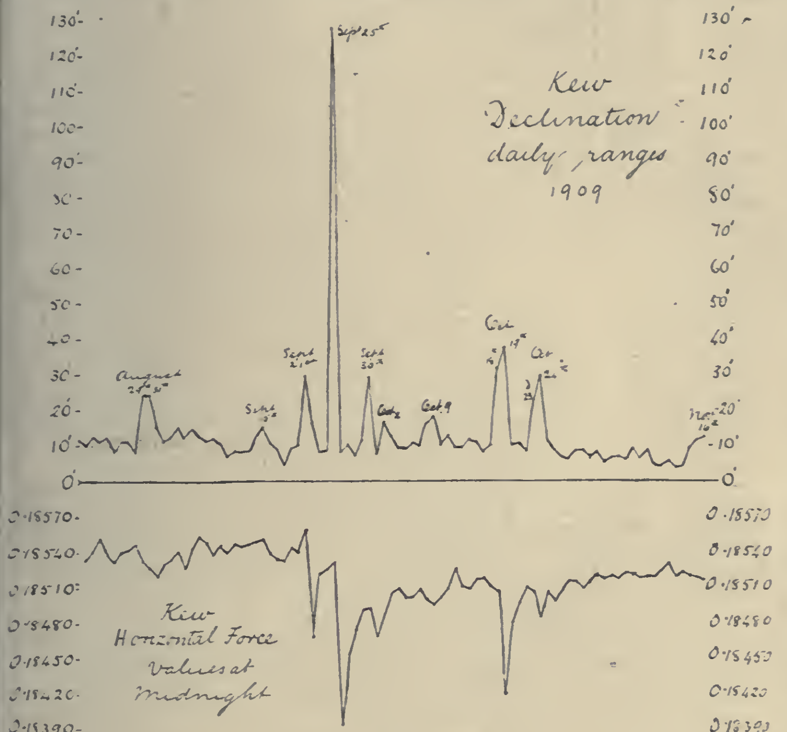


FIG. 2.

Undeterred by these mathematical results, Birkeland assumes that a type of magnetic disturbance, which he calls the "polar elementary" storm, is due to kathode rays from the sun which get within a few hundred kilometres of the earth's surface at considerable distances from a magnetic pole. The paths of approach and retreat are supposed to be radial, and the connecting part horizontal. These "polar elementary" storms were observed on a good many occasions at four temporary Arctic observatories provided with magnetographs, which Birkeland was able to keep in action during the winter 1902–3. The characteristics of "polar elementary" storms are their comparatively simple character and short duration, and the fact that their amplitude—unlike that of Birkeland's "equatorial" storms—is much larger in the Arctic than elsewhere. These storms have at least a general resemblance to a special type of disturbance[1] of which I found numerous examples in the records of the National Antarctic Expedition of 1901–4.

Birkeland found that frequently, after an "equatorial" storm had been in progress for some hours, one or a series of "polar elementary" storms intervened. He obtained copies of the curves taken at a number of observatories on the days of the disturbances recorded by his Arctic stations, and he has reproduced these with his own records in a most valuable series of plates published in his recent monumental work, "The Norwegian Aurora Polaris Expedition, 1902–3," vol. i.

Whilst recognising to the full the devotion with which Prof. Birkeland has prosecuted his investigations into magnetic storms for more than a decade of years, and while admiring the beauty of his experiments, I have to admit that I do not find his explanations convincing. If "equatorial" storms are due, as he believes, to electric currents at great heights above the earth in the magnetic equator, the disturbing force, while approximately horizontal and in the magnetic meridian at places near the magnetic equator, should, even in temperate latitudes, have a considerable vertical component, and near the magnetic poles the vertical component should largely predominate. I am unable to see these phenomena in the curves of Birkeland's own plates. Further, during the time of Birkeland's Arctic expedition the *Discovery* was at work in the Antarctic, and the simultaneous results obtained there do not seem capable of explanation on his hypothesis.

Fig. 3 affords one out of a number of examples of this.

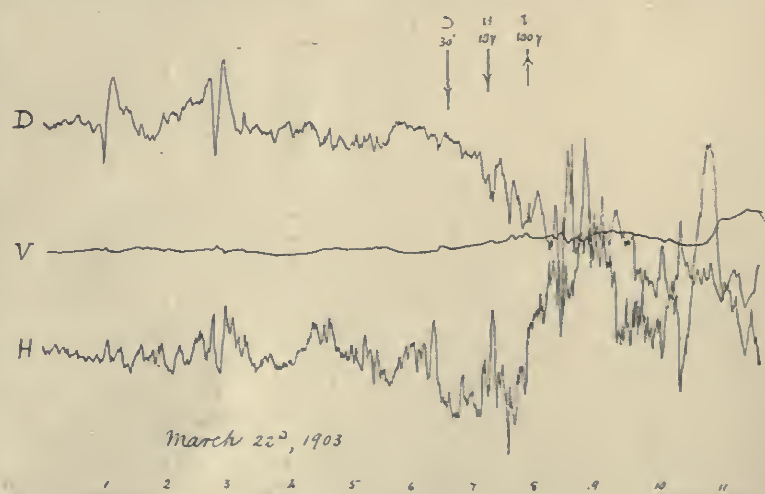


FIG. 3.—Magnetic Storm in Antarctic.

It shows the declination (D), vertical force (V), and horizontal force (H) traces at the *Discovery's* winter quarters on March 22, 1903, during a magnetic storm which forms

[1] *Archives des Sciences physiques et naturelles*, Geneva, 1907.

[1] "National Antarctic Expedition, 1901–4." Magnetic Observations, p. 186.

the subject of Birkeland's Plate xx. Birkeland's curves, representing stations from 77° 41′ N. to 43° 32′ S. lat., all show two small but singularly distinct movements at about 1 p.m. and 2.45 p.m. G.M.T. These he ascribes to an "equatorial" storm. Now if these storms were due, as he supposes, to an overhead current in the plane of the magnetic equator, the vertical force disturbance, as we have seen, ought to have been largely predominant at the Antarctic station, which was only about 400 miles from the south magnetic pole. This is exactly what did not happen. Two movements occur in Fig. 3 exactly synchronous with those elsewhere, but the vertical force movements are much smaller than those in declination, and the disturbance in the horizontal plane is not smaller, but much larger than at the equatorial stations.

Interest also attaches to the large oscillation in vertical force between 9.30 and 11.30 p.m. G.M.T. with the accompanying considerable movements in the other elements. This is precisely the time of a "polar elementary" storm recorded at Birkeland's Arctic stations. A similar coincidence occurred on so many occasions that one can hardly suppose it to be accidental. This suggests a very intimate connection between magnetic phenomena in the Arctic and Antarctic.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. J. H. Jeans has been appointed Stokes lecturer in mathematics from midsummer, 1910.

Mr. W. B. Alexander has been appointed to the office of assistant to the superintendent of the museum of zoology.

The third annual report of the Forestry Committee refers to the work carried on during the past year. In June last the reader, Mr. A. Henry, commenced a series of experimental sowings of the different kinds of elms, which have yielded interesting results, showing that what were supposed hitherto to be varieties of one species, of unknown origin, are in reality combinations of two species, in which the Mendelian ratios are observed. Incidentally, these experiments have directed attention to the astonishing vigour displayed by certain first-crosses in trees, all of which hitherto had arisen in the wild state. An attempt is being made this year to produce artificially similar hybrids in the case of the more valuable kinds of trees, and for the first time, almost, the production of new breeds of forest trees is being tried. A plot on the University farm has been assigned by the Agricultural Department to the reader for forestry experiments, and about 5300 seedling trees, of known pedigrees, are now planted out. A small plot of *Eucommia ulmoides* has been established near Norwich. This tree, which was discovered in the mountains of central China, is perfectly hardy and fast in growth in this country. Its bark produces 5 per cent. of rubber, the quality of which, however, is still a matter of doubt, as only minute quantities have been tested.

GLASGOW.—In order to meet the necessity for increased teaching power in the faculty of arts, the University Court has decided to establish eight new lecturers and assistants in mathematics, natural philosophy, and the several literary and philosophical departments. A separate course in mathematics for students of engineering will be instituted, and better provision will be made for the tutorial instruction of students in smaller classes than have hitherto been practicable.

The annual report of the museums committee testifies to a considerable amount of work in the cataloguing and arranging of the collections under the care of Profs. Graham Kerr and Gregory. Gifts of entire collections, associated with the names of David Ure, Webb Seymour, and Mackenzie, have enriched the geological museum.

At the observatory a new house has been erected for the fine Corbett equatorial.

OXFORD.—The following is the text of the speech delivered by Prof. Love in presenting M. Émile Cartailhac for the degree of D.Sc. *honoris causa* on May 10:—

"Nulli profecto ex eis qui hodie hominum naturae student posthabendus est Aemilius Cartailhac. Qui vir annos viginti quattuor natus commentarios in hoc genere apud Gallos eo tempore maximi habitos, in quibus gentium incultarum mores et vetustatis obsoletae reliquiae tractabantur, edendos suscepit. Quo munere viginti annos functus, cum res ex omni parte terrarum allatas scrutaretur, cum in ea loca ubi eiusmodi monumenta invenienda sunt ipse multas peregrinationes faceret, adeo incendit civium suorum studia ut diversis auctoribus quasi symbolam conferentibus maxima illa Acta conflata sint, quibus edendis ipse multos annos praefuit, quibusque etiam nunc curam impertit. Academiarum quoque Gallicarum rectoribus persuasit ut discipulos in his rebus institui iuberent: ipse Tolosae in sua urbe atque Academia iuniorum studia dirigit. Nihil profecto his diebus magis admirati sumus quam rudes illas picturas in cavernis ubi habitabant homines pristini inventas. Huiusmodi monumentis, quibus maxime abundant Hispania septentrionalis et australis Gallia, hic noster maximam operam dedit, eademque pulcherrime expicta in medium protulit. Iure igitur hic vir tanta doctrina ornatus, scientiae tam deditus, apud cives suos iamdudum nobilis, ubicunque homines haec studia colunt insigni laude celebrandus est."

The first Halley lecture was delivered on May 10 by Dr. Henry Wilde, F.R.S., the founder. The subject of the lecture was "Celestial Ejectamenta." Dr. Wilde maintained that comets originated within the solar system, being the result of explosive discharges from planets, especially the larger planets, in process of cooling.

The Romanes lecture, postponed from May 18, will be delivered by ex-President Roosevelt on Tuesday, June 7. The subject is "Biological Analogies in History." The honorary degree of D.C.L. will be conferred on the lecturer on the same occasion.

The honorary degree of D.Sc., as already announced, will be conferred on Messrs. P. H. Cowell, F.R.S., and A. C. Crommelin, of the Royal Observatory, Greenwich, on Saturday, May 21.

AMONG many other matters of interest dealt with in the second volume of the report of the U.S. Commissioner of Education for the year ended June 30, 1909, special attention may be directed to the gifts and bequests made during the year to promote higher education in America. The total value of all benefactions recorded as having been received by the 606 universities, colleges, and technical institutions reporting to the Washington Bureau in the year under consideration amounted to about 3,561,000*l.* Of this amount, 806,000*l.* was given for buildings and improvements, and 2,244,000*l.* for endowment, the remainder being for current expenses. Thirty-six institutions each received 20,000*l.* or more, and together accounted for 1,972,000*l.* of the above total. Yale University, Connecticut, was helped most generously, having received some 254,600*l.* The University of Virginia was credited with about 157,500*l.*, while the University of Chicago, Illinois, Grinnell College, Iowa, Bowdoin College, Maine, and Washington University, Missouri, each received 100,000*l.* or more. We notice that the 606 institutions referred to employed a teaching force of 26,369, and had an aggregate enrolment of 308,163 students. Of the 606 institutions, 89 are under the control of States or municipalities and 517 are managed by private corporations. It will be noticed that several prominent universities supposed to have received very large gifts during the year are not mentioned in this summary of the official record of benefactions. The Commissioner of Education points out that official statements of the amounts reported to have been received could not be obtained by the Bureau at Washington.

IN the issue of *Science* for April 29 Prof. Guido H. Marx publishes a table showing the attendance of students at American and foreign universities during the session 1906–7. The figures of attendance were furnished to the U.S. Commissioner of Education by the editor of "Minerva." Prof. Marx recognises the probability that the totals he gives may understate, rather than overstate, the attendance in some of the countries which have no

published complete official statistics. The United States is placed first on the list with 212,956 students in institutions of higher education, or one such student to 394 of the population. Of the larger European countries France takes first place with 50,935 students, or one to 771 of the population. Germany comes next, where, including "hearers," the numbers are 73,020 and 830 respectively. Then we have in order Austria-Hungary, 51,691 and 909; Italy, 33,174 and 1014; United Kingdom, 41,305 and 1068; Spain, 15,642 and 1204; and the Russian Empire, 54,208 and 2754. Prof. Marx points out that the total in the case of the United Kingdom excludes 22,159 evening students, and that Prof. B. Menschutkin, writing to NATURE, claimed 76,900 students for the year 1908–9 for Russian higher educational institutions, with the surmise that possibly there were 20,000 more in private higher colleges.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, April 22.—Prof. H. L. Callendar, F.R.S., president, in the chair.—W. A. **Scoble**: Further tests of brittle materials under combined stress. A former paper described tests on cast iron, which is the brittle material which is most commonly employed in engineering practice. The tests described in the present paper were made on hardened cast steel. The specimens were ⅜-inch diameter and 30 inches effective length, and were tested under combined bending and torsion. Neither the maximum shear stress nor the maximum strain was constant at fracture, but the results indicated that the maximum principal stress is the best criterion of strength for a brittle material under combined stress. In general, the hardening did not affect the strength of a bar to resist bending, but it doubled the torque which was required to cause failure.—C. **Cheneveau**, with an appendix by A. C. **Jolley**: The magnetic balance of MM. Curie and C. Cheneveau. This balance is intended for the determination of the coefficient of specific magnetisation, susceptibility, and permeability of feebly paramagnetic and diamagnetic bodies. The body under investigation is suspended from one arm of a torsion balance, which measures the force exerted on the body when it is placed in the non-uniform field of a permanent magnet. The torsion balance is formed by a horizontal rod suspended by a long fine platinum wire, and carrying at one end a hook from which the substance under investigation can be suspended in a small enclosing glass tube. On the other end of the torsion arm a copper sector is fixed which moves between the poles of an auxiliary magnet, and thus provides efficient damping. A second branch arm is also provided, upon which may be placed suitable counterweights to balance the specimen. The suspension carries a mirror, and the movements are read on a translucent scale in the ordinary way.

Zoological Society, May 3.—Dr. A. Smith Woodward, F.R.S., vice-president, in the chair.—Dr. H. B. **Fantham**: (1) The morphology and life-history of *Eimeria* (*Coccidium*) *avium*, a sporozoon causing a fatal disease among young grouse. A detailed account of the morphology and life-history of the Coccidium which destroys the epithelial lining of the duodenum and cæca of grouse chicks, causing enteritis accompanied by diarrhœa. (2) Observations on the parasitic protozoa of the red grouse (*Lagopus scoticus*). Observations on some seven other protozoa parasitic in the blood or in the digestive tract of grouse. None of these parasites, however, could be said to be either numerous or very harmful to the birds examined. (3) Experimental studies on avian coccidiosis, especially in relation to young grouse, fowls, and pigeons. The results of many and varied experiments were recorded in this paper, relating to the time of ripening and duration of infectivity of coccidian oöcysts, their dispersal by insect larvæ, &c., and the effects of various reagents on the oöcysts. The distribution of the parasites within the host was given, and the results of the transmission of grouse coccidiosis to young fowls and pigeons were set forth. (4) Observations on the blood of grouse. The various blood-cells were described, and the results of blood counts (both of red cells and of leucocytes differentially) of healthy and diseased birds were set forth. Both coccidiosis and strongylosis produce anæmia, and the presence of various parasites is also associated with numerical differences in the leucocytic elements of the blood.—Prof. G. O. **Sars**: Report on the Ostracoda collected by the third Tanganyika expedition during 1904–5.—Dr. R. **Broom**: Tritylodon, and on the relationships of the Multituberculata. The author had re-examined the type and only known specimen of Tritylodon, and in one or two points came to different conclusions from Owen and Seeley. Gidley's recent paper on Ptilodus was criticised at some length, and an endeavour made to controvert his conclusion that Ptilodus is allied to the diprotodont marsupials. It was held that while the multituberculates are doubtless very unlike the living degenerate monotremes, they are more primitive than the marsupials, and not at all closely allied to them, and that until the evidence of their affinities is much greater than at present they may well be left as an independent order.

Linnean Society, May 5.—Prof. E. B. Poulton, F.R.S., vice-president, in the chair.—H. **Scott**: Eight months' entomological collecting in the Seychelles.—J. M. **Brown**: Some points in the anatomy of the larva of *Tipula maxima*; a contribution to our knowledge of the respiration and circulation in insects.

DUBLIN.

Royal Dublin Society, April 26.—Dr. J. M. Purser in the chair.—Prof. G. H. **Carpenter**: Injurious insects and other animals observed in Ireland during the year 1909. Among the species recorded are the chalcid fly, *Megastigmus strobilobius*, from silver fir-seed, in the county of Wicklow, and the root-knot eelworm, from tomatoes in a greenhouse at Belfast.—W. R. G. **Atkins**: The cryoscopic determination of the osmotic pressure of some plant organs. A number of fruits and underground organs were pressed, and the freezing points of the juices determined with Beckmann's apparatus. The mean molecular weights of the solutes were also obtained. The pressures in the same organs of different samples of the same species were found to be tolerably constant, as were also the mean molecular weights. Pressures ranging from 5·94 to 29·53 atmospheres were met with in fruits, and from 6·47 to 18·67 atmospheres in underground organs, while the mean molecular weights varied from 76 to 304 in the whole series.—Dr. W. E. **Adeney**: Studies of "streaming" of dissolved atmospheric gases in water.

PARIS.

Academy of Sciences, May 9.—M. Armand Gautier in the chair.—Gaston **Darboux**: A particular class of triple orthogonal systems.—M. Jean Bosscha was elected a correspondant in the section of physics in the place of the late M. Crova.—A. **Bernard** and P. **Idrac**: A second series of researches on Halley's comet and its spectrum made at the Observatory of Meudon. Details of observations following the changes in spectrum and structure commencing on January 7, and carried on to May 7.—J. J. **Landerer**: The polarisation of the light from the moon. A reply to criticisms of the method published in 1889.—M. **Coggia**: Observations of Halley's comet made at the Observatory of Marseilles with the 26-cm. Eichens equatorial. Positions of the comet and comparison stars are given for April 16, 17, 18, 21, 23, 26 to 29, and May 2 to 6. The comet could be seen with the naked eye on April 23 as a star of the third magnitude; on April 26 it had increased in brightness to the second magnitude, with a tail of about 1°. By May 5 the tail was about 10° long.—Paul **Pascal**: The magnetic analysis of some chromophoric groups. A double linkage always reduces the diamagnetism. The application of this to the study of some colouring matters appears to show that the existence of a marked coloration is nearly always correlated with a quinonoid structure, at least in bodies containing oxygen. —Daniel **Berthelot** and Henri **Gaudechon**: The chemical effects of the ultra-violet rays on gaseous bodies. Polymerisation reactions. The action of the ultra-violet rays from a quartz mercury arc lamp on acetylene, cyanogen, and ethylene, either alone or mixed with indifferent gases,

and contained in a thin quartz tube, has been proved to result in polymers being formed. The residual gas in all cases was pure, the polymers formed depositing on the sides of the tube in liquid or solid form. Oxygen under these conditions was proved definitely to give rise to ozone.—Pablo-Martinez **Strong**: The colloidal nature of the chromopolysulphuric acids. It is shown that these acids possess the properties of true colloids.—V. **Volmar**: Some trialkylacetonaphthones and their decomposition by sodium amide. Ketones of the general type

$$C_{10}H_7—CO—C(R_1R_2R_3)$$

have been prepared. These are all split up by the action of sodium amide, the α isomers giving products corresponding to those obtained from the trialkylacetophenones, whilst with the β products the inverse reaction takes place.—V. **Grignard** and L. **Zorn**: The action of thionyl chloride on mixed organo-magnesium compounds. Aromatic magnesium compounds give rise to sulphinones; fatty compounds give a mixture of sulphinone, sulphide, and alcohol.—P. **Freundler**: The chloranthranilic esters and their condensation with nitroso-benzene.—M. **Tiffeneau**: The action of dehydrating agents on some α-glycols.—L. **Lutz**: The mode of formation of gum in Tragacanthoides.—Raoul **Combes**: The part played by oxygen in the formation and destruction of the anthocyanic red pigments in plants. The experiments described prove that when the anthocyanic pigments are formed the oxygen is retained by the organs in process of reddening, and there is at this time an increase in the activity of the oxidation phenomena in these organs. These results confirm those of Molliard.—Vital **Boulet**: The endotroph mycorhizes of some fruit trees.—Henri **Coupin**: The growth of some moulds in oil. The growth of the moulds used in oil resembled the growth in water more than that in air.—M. **Marage**: The development of the energy of the voice. The energy of the voice is proportional to the volume of air expelled from the lungs and the pressure exerted upon it. Respiratory exercises are described for increasing the capacity of the lungs and for strengthening the muscles of the abdominal wall.—Armand **Dehorne**: The longitudinal division of the chromosomes in the spermatogonia of *Sabellaria spinulosa*.—J. P. **Bounhiol**: The thermic region of the Algerian coast. The distribution of the temperature of the sea off the Algerian coast has been studied with a view to the establishment of the sardine in these waters.—G. **Baudran**: The Koch bacilli. A glycerophosphate medium. Maximum doses of iron and alumina.—C. **Gerber**: The caseification of raw milk by the ferments from boiled milk.

DIARY OF SOCIETIES.

MONDAY, MAY 23.

VICTORIA INSTITUTE, at 4.30.—Heredity and Eugenics: the Rev. Prof A. Caldecott.

TUESDAY, MAY 24.

ROYAL INSTITUTION, at 3.—Earth-tides: Prof. A. E. H. Love, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

ZOOLOGICAL SOCIETY, at 8.30.—Observations on the Anatomy and General Biology of some Members of the larger Cetacea: D. G. Lillie.—Zoological Results of the Third Tanganyika Expedition, conducted by Dr. W. A. Cunnington, 1904–1905. Report on the Rotifera: C. F. Rousselet—(1) The Marine Fauna of the Mergui Archipelago, Lower Burma, collected by Jas. J. Simpson and R. N. Rudmose-Brown, University of Aberdeen, February to May, 1907: The Hydroids; (2) Hydroids from Christmas Island, Indian Ocean, collected by Dr. C. W. Andrews, F.R.S., in 1908: J. Ritchie.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

WEDNESDAY, MAY 25.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—Daily Rainfall at the Royal Observatory, Greenwich, 1841–1903: W. C. Nash.—Low Temperature Periods during the Winters 1908–9 and 1909–10: L. C. W. Bonacina.—The Rate of Rainfall at Kew in 1908: R. Corless.

GEOLOGICAL SOCIETY, at 8.—Dedolomitization in the Marble of Port Shepstone (Natal): Dr. F. H. Hatch and R. H. Rastall.—Recumbent Folds in the Highland Schists: E. B. Bailey.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

ROYAL SOCIETY OF ARTS, at 8.—Persia and the Regeneration of Islam: Bernard Temple.

THURSDAY, MAY 26.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: Alterations of the Development and Forms of Plants as a Result of Environment: Prof. G. Klebs.

ROYAL INSTITUTION, at 3.—The Constitution and Internal Structure of Alloys: Dr. W. Rosenhain.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

ROYAL SOCIETY OF ARTS, at 4.30.—The People of Burma: Sir Richard Carnac Temple, Bart., C.I.E.

FRIDAY, MAY 27.

ROYAL INSTITUTION, at 9.—The Forthcoming Antarctic Expedition: Capt. R. F. Scott, R.N., C.V.O.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

PHYSICAL SOCIETY, at 5.—On an Oscillation Detector actuated solely by Temperature Variation of Resistance: Dr. W. H. Eccles.—Exhibition of a Resonance Transformer: A Eagle.—The Limitations of the Weston Cell as a Standard of Electromotive Force: Dr. S. W. J. Smith.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Adjourned discussion* upon Mr. S. N. Brayshaw's Paper on A Research on the Hardening of Carbon and Low-tungsten Tool-steels: Prof. J. O. Arnold.—Comparison of the Tensile, Impact-tensile, and Repeated-bending Methods of Testing Steel: B. Blount, W. G. Kirkaldy, and Capt. H. Riall Sankey.

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THURSDAY, MAY 26, 1910.

THE LAST DAYS OF CHARLES II.

The Last Days of Charles II. By Dr. Raymond Crawfurd. Pp. 80. (Oxford: Clarendon Press, 1909.) Price 5s. net.

CHARLES II. died at midday on Friday, February 6, 1685, at the age of fifty-three. His last illness seemed to his courtiers to begin on the morning of Monday, February 2, with an attack of convulsions. He was bled, and became conscious and able to speak; on Thursday had more convulsions, with intervals of consciousness, and on Friday morning, after an attack of breathlessness, gradually became insensible, and so died without further convulsion. His body was examined after death; the blood-vessels of the brain were found distended, there was an excess of serum in the cerebral ventricles, the heart was large and firm, and, except an old pleural adhesion on the left side and a general engorgement of the liver, spleen, and kidneys, there were no other signs of disease. From these facts, as set forth in detail in contemporary evidence, Dr. Crawfurd arrives at the conclusion "that his death was due to chronic granular kidney (a form of Bright's disease) with uræmic convulsions."

Dr. Crawfurd's interesting book begins with an account of the authorities. These are the memoirs of Thomas, Lord Ailesbury, who was in waiting upon the king; the despatches of Barillon, the French Ambassador; those of the Dutch Ambassador; the diary and letters of Philip, Earl of Chesterfield; a letter to Mr. Roper, a fellow of the College of St. John the Evangelist; the life of James II., based on his memoirs; the narrative of Father Hudleston, the priest who was brought in to the dying king; and the account of the illness written by Sir Charles Scarburgh, the learned royal physician. Scarburgh had received one of the highest honours which a physician could attain in that century, the friendship of Harvey, and his account of the progress of the illness and of each consultation, of the treatment and of the autopsy are unexceptionable evidence. Of equal value as regards truthfulness, though looking at what passed in an entirely different way, is the simple narrative of Father Richard Hudleston, a Benedictine to whom, by some slip of memory, Lord Macaulay has attributed a want of education which the narrative alone is sufficient to disprove. The accounts of Lord Ailesbury, Lord Chesterfield, and James II., and of Barillon, who were all present, supply further and, in the main, trustworthy details. The letter of the Rev. Francis Roper is less important, but shows the feeling of the time.

The king had excellent medical advice. Edmund King, who took the first step in treatment, was a man of great experience in all parts of his profession and had a scientific mind; Dr. Richard Lower was one of the first discoverers of the nature of dropsy; Dr. Frazier had been attached to the king, and attended him in poverty and exile as well as in prosperity; Dr. Walter Charleton had lived a long life among the learned; Dr. Martin Lyster had a mind attentive to every part of science, and a most tender heart; Sir Thomas Witherby was the president of the College of Physicians. The greatest of English physicians thought so well of Dr. Thomas Short that he dedicated to him his treatise on gout and dropsy. Dr. Edmund Dickenson was a man of great general learning who had spent much time in chemical studies. Dr. Edward Browne had been trained from boyhood in literature, philosophy, and medical observation by his celebrated father, Sir Thomas Browne. Sydenham, in his account of the irregular smallpox, speaks of Millington as his friend and as a learned and candid physician, and Garth says of him—

> "At your approach the baffled tyrant Death
> Breaks his keen shaft and grinds his clashing teeth."

Barwick was devoted to the royal family, and was a very competent physician. Thus the king had the good fortune to be treated by a group of learned men, among whom were several first-rate observers.

At the present day, if the fourteen most distinguished physicians of the College were at the bedside of a patient afflicted by the convulsions which often terminate diabetes, the knowledge which they could bring to bear upon the problem of treatment before them would be but little more than that which their fourteen predecessors possessed of the last illness of Charles II. Since 1685 Blackall and Bright, and many other investigators, have made clear the whole morbid anatomy, and something of the pathology and treatment, of chronic granular kidney and uræmic convulsions, and thus Dr. Crawfurd is able to give good reasons for his opinion of the cause of the king's death. His hypothesis explains satisfactorily the king's intervals of consciousness, and is further confirmed by the entire absence in the accounts of the eye-witnesses of any evidence of paralysis such as would almost certainly have been noticeable had cerebral hæmorrhage been the cause of death.

Dr. Crawfurd shows that the facial paralysis imagined by Sir Henry Halford to be represented in the wax figure of Charles II. at Westminster is not present. He is, perhaps, not quite just to the attainments of Wellwood as shown by his "Banquet of Xenophon" and other writings, and by the general opinion of his contemporaries. He is also unintentionally unjust to one of the physicians who signed the prescriptions given in the account of Scarburgh, which he has printed in full. This is Dr. Christian Harel, manager of the Royal Laboratory, whose acquaintance Charles probably made at Aix-la-Chapelle, and who was a man of great perseverance and some ability. His name is erroneously transcribed C. Farwell, E. Farrell, C. Farel, and C. Farell. He afterwards became physician to Queen Mary.

MECHANICAL LITERATURE OF THE NINETEENTH CENTURY.

Royal Society of London. Catalogue of Scientific Papers, 1800–1900. Subject Index, Vol. ii., Mechanics. Pp. lxxiii+355. (Cambridge: University Press, 1909.) Price 15s. net.

THIS second volume of the Royal Society's subject index illustrates the difficulties, as well as the merits, of the undertaking. The vagueness of the

boundary between mechanics and mathematics, on the one side, and between mechanics and physics on the other, must have given some trouble, but this kind of problem seems to have been dealt with fairly satisfactorily. The difficulties of internal classification, on the other hand, are most perplexing and baffling. One constant source of difficulty is that the mere title of a paper often gives a wholly inadequate, or even a misleading, notion as to its real scope; the same paper may, moreover, contain matters which in any complete system of classification would fall under quite distinct headings. As regards papers published since 1883, the editors have attempted to deal with this point, and we are told that in all such cases the contents have been examined by experts. It is unfortunate that the same process could not be extended backwards so as to cover the whole century, but the labour involved would have been enormous, and the result at the best imperfect.

The schedules adopted as the basis of classification are those of the International Scientific Catalogue, but a number of subheadings have been introduced. These are printed in a somewhat aggressive type, and distract attention perhaps as much as they assist it; indeed, we have found that some little practice is necessary before the volume can be used with effect. It is possible to set oneself some rather interesting problems in hunting up known papers; we may suggest, for instance, a search for references to Hamilton's memoirs on varying action, Kirchhoff's theory of the vibrations of a circular plate, or his experimental method of determining elastic constants, and Hertz's paper on the pressure of elastic solids in contact. These are, of course, all in the book, but they may take some finding.

It would be ungracious to dwell further on imperfections which must occur on almost any practicable system. It is pleasant to turn to points which can be commended without reserve. The list of serials which have been used for the purposes of the work, and the indication of the more important British libraries where these are to be found, will save much trouble to scientific workers. Very welcome, also, as well as important from the point of view of scientific history, are the references to biographical articles; these seem to be especially full and complete. The lists of general treatises, tables, public addresses, and books on apparatus strike us, on the other hand, as somewhat meagre. Possibly they are merely receptacles for a few odd items for which place could not be found elsewhere.

When all is said, an index to the mechanical literature of the whole nineteenth century, drawn up on a consistent plan, cannot fail to be an enormous boon to students and investigators. These are once more under a deep obligation to the Cambridge University Press, which has undertaken the complete risk of printing and publishing the work. We would endorse the closing words of the preface, which express a hope that the scientific world generally will "use their best endeavours that this public-spirited action shall not result in financial loss."

SHELL-FISH INDUSTRIES.

Shell Fish Industries. By Prof. J. L. Kellogg. Pp. xvi + 361. (New York: Henry Holt and Co., 1910.) Price 1.75 dollars net.

IN this work Prof. Kellogg gives a very interesting account of the shell-fish industries of the United States, and also a very valuable summary of our present knowledge of the morphology and life-histories of the edible molluscs which form the material of those fisheries. The keynote of the book is the insistence on that waste of great natural resources, and indifference to the needs of the future which have characterised American exploitation. Past generations may have believed that the natural wealth of the continent was inexhaustible, but the present one, by mercilessly clearing up what remains, has established a record of waste which is probably without parallel in the history of peoples. The picture of wastefulness and lawlessness presented by the account of the great Chesapeake oyster fishery given in this book will seem almost incredible to European readers—even to those who know how State control of the sea-fisheries has generally given origin to a mass of futile and vexatious legislation. We read of insufficient surveys resulting only in insecure titles; of conflicting laws; of the utilisation of political machinery to secure immunity from State interference; and of an entirely inefficient fishery police. The earlier oyster-dredgers are described as being commanded by "as merciless a band of pirates . . . as ever ruled a deck on the high seas," and manned by "vagrants, thieves, and murderers," or by newly arrived and ignorant foreigners. The crews of these vessels suffered "abject slavery" and "unspeakable cruelties." They formed "one of the most depraved bodies of workmen to be found in the country." The Baltimore vessels "established a record of crime and cruelty such as has rarely been equalled." The fishery was entirely the exploitation of originally very rich natural beds, and it is not surprising that depletion of these has taken place to such an extent that many areas are now barren.

The natural reaction to such a condition of affairs is scientific investigation, competent and honest surveying, and the study of methods of cultivation. This side of the question is illustrated by an account of the great oyster fisheries in Long Island Sound and adjacent waters. Here State control has suppressed disorder, and has established security of tenure in the case of the partition of the sea-bottom among the holders. Methods of cultivation—seeding, culling, deposition of cultch, and destruction of starfish and other oyster enemies—have made the sea vastly more prolific than in natural conditions; and so we find an output of enormous proportions, and steam dredging vessels without parallel elsewhere among fishing nations. The same line of development is already indicated in the case of other American shell-fisheries.

The parts of the book dealing with these matters—the history of the industry and the methods of cultivation—will prove most interesting to general readers and to those who study fishery questions, but the purely scientific chapters in Prof. Kellogg's book are

also of great value. The first three chapters, and some later ones, give a good account of the life-histories of the oyster, the clams (Mya and Venus), and the scallops (Pecten). One chapter deals with the ciliary mechanisms in some of these animals, and, being based on original observations, contains much that will probably be new to most zoologists. There is also an interesting chapter on bivalve molluscs in relation to human disease. Prof. Kellogg's book may confidently be recommended to all biologists interested in the economic side of their science. J. J.

THE FAUNA OF CEYLON.

Über die Geschichte der Tierwelt von Ceylon. By F. Sarasin. Zool. Jährbucher, suppl. 12, part i. Pp. 160. (Jena: G. Fischer, 1910.) Price 7 marks.

SINCE this elaborate piece of work embodies the results of the biological investigations undertaken by the Messrs. Sarasin in Ceylon during a protracted period, it has good claim to rank as the most authoritative attempt to explain the origin and relationships of the fauna of that island yet published. It is, however, really more than this, as it embraces a survey of the relationships and probable migrations of the faunas of south-eastern Asia generally, and their connection with that of Africa. Very valuable are the details given with regard to the geographical range of the various genera of mammals, reptiles, molluscs, planarians, and worms constituting the Ceylon fauna. Ceylon, which long formed a portion of "Gondwanaland," and is thus of great antiquity, appears to have been isolated from the Indian mainland during the whole or the greater portion of the Pleistocene period.

From this antiquity—in which the island presents a striking contrast to Celebes—the fauna of Ceylon displays unmistakable evidence of a very mixed origin, both as regards space and time. Not fewer than three epochs of connection between the Oriental region and Africa have left their impress on the Ceylonese fauna, one of these periods of union being pre-Cenomanien, while a second was Siwalik. Special emphasis is laid by the author on the part played during the Eocene in the evolution of the fauna of Ceylon by the irruption of the Deccan traps, which for a considerable period formed an impassable belt, dividing the peninsula into a southern area, including Ceylon, and a northern area. Even after the cessation of volcanic activity, communication between these two areas was greatly restricted, consisting of one track on the western and another on the eastern side of the peninsula, and even then practicable only to animals capable of withstanding a considerable amount of drought. The Siwalik connection the author considers took place by way of Baluchistan, Persia, Arabia, and Syria, or possibly to the south of Arabia by way of Socotra; and the author agrees with Dr. Arldt that the connecting area was originally clothed with forest, and that the affinity of the faunas of the African forest-zone, the Malay countries, and southern India and Ceylon may be accounted for by the subsequent deforestation of the tract, and the retreat of the animals to districts where suitable conditions still remained.

Dr. Sarasin likewise admits a former connection between Ceylon and eastern Africa and Madagascar; but considers that a chain of islands will explain the facts of the case, and that recourse to a continental "Lemuria" is quite unnecessary. He likewise accepts a connection with the Malay islands, probably by way of the northern part of the Bay of Bengal, and has also something to say with regard to the South American affinities of the Indo-African fauna. In Ceylon itself the older forms of life, such as planarians, worms, and molluscs, have a very different distributional history from those of the later mammals, and thereby present another contrast to Celebes, where the advent of all was synchronous. A valuable digest of the previous literature concludes this excellent piece of work. R. L.

THE PHILOSOPHY OF EXPERIENCE.

The Principles of Pragmatism: a Philosophical Interpretation of Experience. By H. Heath Bawden. (Boston and New York: Houghton Mifflin Co., 1910.) Price 1.50 dollars net.

THIS is an altogether admirable exposition of the views which are usually associated with the names of Peirce, James, and Dewey in America, and Schiller in England. It does not claim to construct a system, but only to show how we may establish the basal conceptions of a new philosophy of experience.

Pragmatism is the reaction from a speculative philosophy which was out of touch with the affairs of men. The practical man follows with interest the development of a working hypothesis in science, but is impatient of speculations on the infinite and eternal. He values thinking, but he insists that thought shall keep close to experience. He has no use for empty abstractions. The metaphysician has spun a universe out of his own inner consciousness, and tries to make the facts fit his system. The pragmatist seeks the cooperation of the man of science in constructing a philosophy which shall be accurate in method and shall fit the facts.

Philosophy must start, not with a great First Cause or absolute, but with concrete, workaday human life. It must try to understand experience here and now, and from that as a basis proceed to work outward to the metaphysical problems. All the problems of origin and destiny need to be re-stated in terms of present experience. Such a procedure, if it does not much reduce the number of mysteries which lie about us, will at least save us from multiplying them unnecessarily.

The question of immortality, for instance, turns on the nature of individuality. In spite of all the arguments—theological, intuitional, revelational, ethical, and what not—most persons find their faith in a future life scarcely more than a wish. Why? Because the self for whose immortality they hope is an unreal abstraction.

"The self is conceived as a particularistic entity, with barriers to other selves. While, in society, indi-

viduals are recognised to be functions of each other, at death they are supposed to shrivel into isolated and alien units."

The only future that is possible is an immortality of function. An organism is nothing but a centre or focus through which the world-energy operates. When the organism is lost in what we call death, the function may well enough go on in terms of more subtle forms of energetic activity (*cf.* Prof. James's little book, "Human Immortality").

Perhaps, if a criticism may be ventured, modern "psychology-without-a-soul" has become *too much* afraid of being metaphysical. A function must be a function of something. If there is an act, there must be an actor who is, in a way, greater and more real than the act. A soul-entity, then, is justified. It is as reasonable to posit it as to posit a surviving "function."

But the volume is full of deep and careful thinking, and is suggestive and stimulating even in its more questionable doctrines. The analysis of consciousness, and the chapters on the test of truth and on mind and matter, are particularly good.

SOME GERMAN MATHEMATICAL TREATISES.

(1) *Einführung in die Vektoranalysis, mit Anwendungen auf die mathematische Physik.* By Prof. Richard Gans. Zweite Auflage. Pp. x+126. (Leipzig: B. G. Teubner, 1909.) Price 3.60 marks.

(2) *Die Vektoranalysis und ihre Anwendung in der theoretischen Physik.* By Dr. W. v. Ignatowsky. Teil I. Die Vektoranalysis, pp. vii+112. Teil II. Anwendung der Vektoranalysis in der theoretischen Physik. Pp. iv+123. (Leipzig: B. G. Teubner, 1909–10.) Price 6 marks.

(3) *Vorlesungen zur Einführung in die Mechanik raumerfüllender Massen.* By Prof. Alexander Brill. Pp. x+236. (Leipzig: B. G. Teubner, 1909.) Price 8 marks.

(4) *Funktionentafeln mit Formeln und Kurven.* By Prof. Eugen Jahnke and Fritz Emde. Pp. xii+176. (Leipzig: B. G. Teubner, 1909.) Price 6 marks.

(5) *Die Zentrifugalkraft.* By Prof. Friedrich Poske. Pp. 80. (Berlin: Julius Springer, 1909.) Price 3 marks.

(6) *Interpolationsrechnung.* By Prof. T. N. Thiele. Pp. xiii+173. (Leipzig: B. G. Teubner, 1909.) Price 10 marks.

(1) THE simplified system of vector analysis promoted by Gibbs and Heaviside has met with such general acceptance in Germany that treatises and memoirs on subjects of mathematical physics are now often hardly intelligible to readers who do not possess some familiarity with the notations and processes of the calculus in question. A demand has thus arisen for elementary expositions limited to what is absolutely necessary for physical purposes. The first book on our list, now in its second edition, is written mainly with a view to the electrical applications. It deals in a clear and simple fashion with the fundamental operations, and then passes on to the discussion of vector-fields. An interesting chapter on "tensors," which have a bearing on the theories of stress and of quadratic moments, is added. The work closes with a few elementary applications to hydrodynamics and electromagnetism. It may be commended as giving in a very brief compass almost all that is of importance to the physical student.

(2) This work consists of two parts. In the first of these vector analysis is developed from its foundations as an independent discipline, without any reference to Cartesian or other special geometrical coordinates. The author claims some degree of novelty for his methods of exposition, we think with justice. In particular the intrinsic nature of Hamilton's operator ∇, whether as applied to a scalar quantity, or by scalar multiplication to a vector, or by vector multiplication to a vector, is here explained with great insight and (we believe) originality. The passages in question may be recommended to the notice of those who have felt the inadequacy of the usual Cartesian treatment of the matter. The theorems of Green and Gauss naturally present themselves for discussion, and, as in the preceding work, a chapter is added on tensors. The second volume contains a number of applications to elasticity, hydrodynamics, electricity, and crystalline reflection.

(3) This is a course of lectures on the dynamics of continuous systems, written from a special point of view. The inspiration is derived from Hertz, but the author prefers to employ Gauss's principle of least constraint rather than the Hertzian law of the "straightest path." The treatment is somewhat academic, in the sense that stress is laid on unity of method rather than on the specific interest of the various topics discussed, but it is marked by clearness and great mathematical elegance. The subjects considered include the kinetics of rigid bodies and of fluid and elastic media, and, finally, the electromagnetic theory of light. On one point a protest should, in the opinion of the present writer, be entered. The notion that the apparent potential energy of a dynamical system may be accounted for as the kinetic energy of latent internal motions is here, as in many recent Continental writings, attributed too absolutely to Hertz. If nowhere stated so explicitly, perhaps, it must have been present to the mind, not only of Lord Kelvin, but of all students of his various expositions of the theory of gyrostatic systems, to say nothing of the well-known "kinetic theory" of elasticity.

(4) This is intended as a supplement to the ordinary tables of mathematical functions. Of recent years a great deal of work has been done, especially in this country, in tabulating the functions which occur in various important problems of mathematical physics, but the results are scattered in the proceedings of societies and in scientific journals, and are often unavailable, and even unknown, to those who have most need of them. The authors of the present treatise have collected a number of such tables, and have appended explanations of the notations, and lists of the important formulæ. The whole is brought within a moderate compass by restricting the entries to four significant figures; this is, of course, ample for most physical purposes, and more than sufficient for graphical representation. We are

glad to note that the author pays a tribute to the British Association Committee on Mathematical Tables, the activity of which has, unfortunately, in recent times somewhat slackened. The collection includes tables of the sine-integral, cosine-integral, and exponential-integral, the Fresnel transcendents, the gamma-function, the error-function, elliptic integrals, spherical harmonics, and the Bessel's functions of both kinds. Especially welcome are the tables of the latter function in which the argument is complex.

Every worker in applied mathematics will applaud this publication, and will wish it such success that it may be speedily followed by new and still more comprehensive editions.

(5) A "philosophical" discussion of the nature of centrifugal force is hardly suited for review in these pages. Such discussions are apt to resolve themselves into verbal questions, and we fear that the present one is no exception. The author insists, for example, on a distinction between "motive forces" and "resistances," the tension of a string being reckoned as belonging to the former category, the pressure of a smooth surface to the latter! The tract is lengthy and diffuse.

(6) A formal treatise on the theory of interpolation from the former professor of astronomy at Copenhagen is sure of respect. The present work is carefully written, and apparently from an independent standpoint. There is, indeed, hardly any explicit reference to the work of previous writers other than Newton and Lagrange, and novel notations are introduced freely without any reference to accepted forms which have long been in general use. The author claims for the subject an important place in schemes of mathematical instruction. To this we can hardly assent; processes of interpolation are, of course, constantly required, in one form or another, but a systematic study of the subject as an independent discipline would, in the case of most students, be an unnecessary infliction. The case of those who are training to become experts in certain special subjects is, of course, different.

H. L.

OUR BOOK SHELF.

An Introduction to Petrology. By F. P. Mennell. Second edition. Pp. viii+204. (London: Gerrards, Limited, 1910.) Price 8s. net.

THIS is a plain and clearly written introduction to a branch of geology that has assumed much importance among students, and it has the merit of including a short description of the minerals that go to make up rocks. The author's personal studies, as is well known, have been carried on mainly in Rhodesia, and there is something pleasant in finding familiar facts illustrated from Bulawayo, Kimberley, or the Rand. The palisade structure of basaltic flows is thus well seen in the view of the Zambezi gorge on p. 92. In addition, we gain by the introduction of the results of tropical weathering on rocks; and the remarkable banded siliceous ironstones of South Africa (p. 180) are referred to the concentration of mineral matter in a stratified series near the surface.

Theoretical questions are touched on sufficiently to arouse interest, and a sane balance seems to be preserved between what can be seen in the field and what may be variously inferred. The discussion of the absorption of schists and sediments by the granite of the Matopos and Mashonaland is sustained by evidence that seems convincing, and it has been our good fortune to go over something of this ground in the company of the author. The arguments derived from the amphibolites (p. 171) might have been supported by work of earlier date than that quoted, such as that done in Saxony and round Mont Blanc; but the introduction of matter of this kind, of chapter xiii. (on the origin and variations of igneous rocks), and of the well-reasoned chapter xix., on metamorphism, show that the author regards petrology as far more than the mere description of rock-specimens. Enough is said on each point to show what researches lie before the worker in the open country.

Simple and descriptive as the book is, it will undoubtedly encourage thought in all who read it. The illustrations are excellent, though we should like fewer rock-sections, and more landscapes, such as that on p. 101. Very few misprints—"Brux" for "Brüx," "Fougué" for "Fouqué," and "entectic" for "eutectic," twice on p. 89—have been noted. The formulæ of the silicates might be modernised in the next edition, since comparison is thus rendered more easy. On p. 70 the resemblance between kaolin and serpentine is unnecessarily obscured by a small difference of method. A comma is wanted in the dolomite formula on p. 75; but is not this better written $MgCa(CO_3)_2$? The change of appearance in a section of calcite when the polariser is rotated beneath it (p. 75) is due to differences in "relief" at the surfaces, and not to differences of absorption within the section. This well-printed book, as a whole, is a very pleasant one to read.

G. A. J. C.

Map of Eastern Turkey-in-Asia, Syria, and West Persia. Scale, 1/2,000,000, or 1 inch=31·56 miles. (London: Royal Geographical Society, 1910.)

THE issue of this map occurs at an opportune moment. Public attention has been much directed lately to the once fertile strip of country that lies between the deserts of Arabia on the one hand, and the mountains of Asia Minor on the other. It is needless to dwell here on the visions of the past that a mere inspection of the names on this map will call up in the mind of the historian. Looking to the future alone, it is obvious that we have before us the representation of a piece of country destined once again to play an important part in human history, and to be the scene of a busy commerce and a thriving agriculture. Whatever be the political difficulties now blocking the way, it is certain that before very long we shall see the construction of the railway joining the Mediterranean with the head of the Persian Gulf, a route possibly extending through southern Persia and Baluchistan to India itself. In the more immediate future we shall see the rich land that lies between and about the great twin rivers wake from its sleep of four centuries and water again flow through canals and irrigation channels long choked with the desert sands.

The report on the irrigation system recently published by Sir W. Willcocks makes it clear that, with no great engineering difficulties, and even with no great expenditure of capital, some, at all events, of the old irrigation works can be reopened and a large area of land once more taken into cultivation. The enterprise and energy with which this work is now actually being taken up is the best evidence of the change that has come over the spirit of Turkish administration since the advent of constitutional government.

It is sincerely to be hoped that the prime importance of carrying out an accurate survey in advance of agricultural development will not be lost sight of. In

this matter the example of Egypt should be constantly borne in mind, both as showing the difficulties and loss incurred when survey is allowed to lag behind the necessities of land development and taxation, and also as an example of the methods upon which the cadastre of such a piece of country should proceed. The map before us is produced in the excellent style that its origin would lead us to expect, and the thanks of all geographers are due to its compilers and publishers. E. H. H.

The Anatomy of the Common Squid, Loligo Pealii, Lesueur. By L. W. Williams. Pp. xv+92. (Leyden: late E. J. Brill, n.d.) Price 10*s.*

THIS work, published under the patronage of the American Museum of Natural History, but printed in Holland without date, is a very complete and well-illustrated description of the anatomy of one of the commonest Cephalopods. As such it should meet with a warm welcome from all serious students of the mollusca. We believe the squid is a type not usually dissected by zoological students in this country, but for the sake of comparison, at any rate, the work should find a place in the zoological laboratory.

We do not expect very much in the way of novelty in a memoir of this kind, but the author is to be congratulated on the important discovery of a pair of giant nerve-cells situated in the pedal ganglion, and each giving off a giant fibre. The giant fibres pass backwards to the centre of the visceral ganglion, where they cross one another, forming a "chiasma"; each fibre then passes on through the viscero-stellate connective to the stellate ganglion of the side opposite its origin, where it divides into a number of branches, one of which enters each of the larger nerves given off from that ganglion. There appears to be no doubt about the facts of the case, which are sufficiently remarkable, but the term "chiasma" hardly seems suitable for the simple crossing of a single pair of fibres. According to the author, this is the first time such fibres have been described in any mollusc, though similar structures are, of course, widely distributed throughout the animal kingdom. We may mention that in the first text-figure we have what seems to be a variation of Lankester's well-known schematic mollusc which does not appear to us to be any improvement on the original.

The Siege and Conquest of the North Pole. By George Bryce. Pp. xvi+334. (London: Gibbings and Co., Ltd., 1910.) Price 7*s.* 6*d.*

As a record of a group of Arctic journeys which had the object of attaining the North Pole, this volume has a real value. It gives, usually in the explorers' own words, the most stirring stories of the Far North, many of which are now difficult to procure in the original form. The record only deals with the last hundred years, the three centuries of earlier efforts being dismissed in a brief introduction. The expeditions chronicled are those of Parry in 1827, Kane in 1853–5, Hayes in 1860–1, the German expedition of 1869–70, the *Polaris* expedition of 1871–3, the Austro-Hungarian expedition of 1872–4, the British expedition of 1875–6, the voyage of the *Jeannette* in 1879–81, Greely's in 1881–4, Nansen's in 1893–6, Sverdrup's in 1898–1902, the Duke of the Abruzzi's in 1899–1900, Peary's from 1886 to 1909, and lastly, Cook's in 1907–9. There were, of course, several other expeditions in the period covered, some, such as Andrée's, avowedly aimed at the pole; others, like the Jackson-Harmsworth, the Ziegler, and the Wellman expeditions, in which the attainment of the pole was at least as much an object of ambition as was the case with Nansen, and much more so than with Greely or Sverdrup. We are, indeed, inclined to suspect that the hope of gaining the fame of first reaching the pole has animated a good many explorers whose ostensible ideals were more modest.

The author's comments and criticisms are few, but usually sound; and we are the more surprised to find that in the light of the adverse opinion of the University of Copenhagen he was able to say "it is impossible at present to pronounce a final judgment" on the story of Cook's journey in 1908. The summing up is strongly in favour of Dr. Cook's claim, and Mr. Bryce does not seem to be staggered by the coincidence of a group of highly improbable statements. He seriously reproduces, without comment or criticism, the absurd assertion that, after finding a latitude of 89° 59′ 45″, the explorer advanced "a distance equal to the 15″." With the exception of the last chapter, however, we can commend the book unreservedly as giving in brief compass a graphic account of many of the greatest trials of human endurance. The sketch-maps suffer from the common fault of being over-reduced, but they help the reader to follow the narratives all the same.

The author does not point out, but the book itself bears abundant testimony to the fact, that the greatest results have been gained since the naval or military organisation of polar expeditions has been abandoned, and the personal ambition or scientific zeal of the leader has become the driving power of a small, well-equipped party, strong in the realisation of the lessons of past failure.

Les États physiques de la Matière. By Prof. Ch. Maurain. Pp. 327. (Paris: F. Alcan, 1910.) Price 3.50 francs.

THIS book is, as the title suggests, an exposition of the properties of matter in its various states. The author confesses, however, in his introduction, that he is principally concerned with the properties of crystals, the different states of solid bodies, liquid crystals and colloids. Thus we find only twenty-three pages devoted to the study of gases, and rather more than fifty to that of liquids. Prof. Maurain has found it convenient to preserve the old divisions of solid, liquid, and gas, but he points out that the distinctions are as regards degree only, and that no properties are peculiar to a particular state.

The treatment is practically devoid of mathematics. The contents of the book are mainly a collection of experimental facts, particularly those which have been brought to light by the use of the microscope and ultramicroscope. The former as applied to crystals, and the latter to emulsions and colloids, have recently widely extended the knowledge of these states of matter.

There are, in all, eleven chapters. The first is devoted to gases and gaseous ions. Reference is made to the kinetic theory, and estimates are given of the sizes and masses of the molecules. The second chapter deals with the properties of liquids. Much attention is paid to the question of the thickness of liquid films and its bearing on the molecular dimensions, and there is also included a discussion of the various methods of estimating the molecular weights of substances. In the next three chapters the properties of solid bodies are fully treated. The various systems of crystals are defined, and examples are given of their directed properties relating to thermal and electrical conductivities, elasticity, magnetism, and optics. The crystalline structure of solid bodies as seen through the microscope is described, and is applied to explain the various properties of metals. Chapter vi. deals mainly with the production of double refraction in isotropic bodies by external means, such as mechanical pressure and electric and magnetic fields. Liquid crystals form the subject of chapter vii. The special properties

of thin solid films are next treated, including Quincke's experiments on the range of molecular action. Chapter ix. is devoted to the behaviour of homogeneous mixtures, both liquid and solid, and chapter x. to heterogeneous mixtures, such as alloys and mixtures of salts. The concluding chapter concerns colloidal solutions, their preparation, structure, &c.

The book, as a whole, is very good. It contains a large fund of information, clearly put and in logical order. It is therefore both readable and instructive.

Aids to Microscopic Diagnosis (Bacterial and Parasitic Diseases). By Capt. E. Blake Knox. Pp. viii+156. (London: Baillière, Tindall and Cox, 1909.) Price 2s. 6d. net.

THIS little book is a *résumé* of clinical methods as applied in the diagnosis of bacterial and parasitic infections of man, and contains a large amount of useful matter in a small space. It is not meant to take the place of the ordinary text-books on these subjects, but to be used for revision purposes, and will be found handy by travellers who are unable to burden themselves with many books. Protozoal organisms, such as malaria, trypanosomes, and spirochætes, filaria, pathogenic bacteria, and the diseases they cause, pathological secretions, the opsonic index, and vaccine therapy are all dealt with, together with the methods required to demonstrate and isolate the causative organisms.

We have noticed a few slips and omissions, *e.g.* the *Streptococcus pyogenes* is spoken of as the *S. pyogenes aureus*; no mention is made of the fact that the *Staphylococcus pyogenes* group liquefies gelatin, while the *Staph. cereus* group does not; it is questionable if the tubercle bacillus can ever be detected in the blood; the term "subtertian," now commonly applied to the malignant form of malaria, is not mentioned; toxin and not dead culture is used for the preparation of diphtheria antitoxin; prophylactic vaccination in cholera is given under the heading "serum therapy," &c. Within the limitations stated by the author, we think a useful purpose will be served by this little book. R. T. HEWLETT.

Lift-Luck on Southern Roads. By Tickner Edwardes. Pp. xv+301. (London: Methuen and Co., 1910.) Price 6s.

HERE is a pleasantly written description of a journey, of some two hundred miles, through five southern English counties, on an unusual plan. Mr. Edwardes says, "My plan consisted in waiting by the roadside or strolling gently onward, until something on wheels, it mattered not what, overtook me . . . by dint of laying under use the whole gamut of country perambulation, at length, after many days of travel, I found myself at my journey's end." Having only a camera and a pack, the author was able to go into every byway he fancied and investigate any subject which presented itself. His account of his wanderings and his illustrations will delight all lovers of the country.

Praenunciae Bahamensis. II., Contributions to a Flora of the Bahamian Archipelago. By C. F. Millspaugh. (Chicago: Field Museum of Natural History, 1909.)

THIS is the second fascicle of a contribution to a flora of the Bahamian Archipelago, issued by the Field Museum of Natural History. It contains observations on old species, the establishment of the new genus Euphorbiodendron, and the description of eleven novelties distributed among the genera Dondia, Portulaca, Chamæsyce, Croton, Centaurium, Heliotropium, Varronia, Catesbæa, and Callicarpa, collected in fifteen different islands of the group.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Halley's Comet and Magnetic and Electrical Phenomena.

HALLEY'S comet has been a source of interest to magneticians as well as to astronomers. The question was: Would the proximity of the comet's tail occasion a magnetic storm or would it not? If the tail consists of electrified particles, and if it were to envelop the earth, then a magnetic storm appeared a reasonable concomitant. It was thus with some expectancy that I consulted the magnetic curves recorded at Kew on May 19. The conclusion that will be drawn from these and similar records will, I suspect, depend somewhat on the temperament of the inquirer. A large magnetic storm unquestionably there was not, but there was disturbance.

The position may perhaps be best explained by reference to the international lists that are published as to the magnetic character of individual days. Days are classed as "0," "1," or "2," according as they are magnetically quiet, moderately disturbed, or highly disturbed. Taking the three years 1906, 1907, and 1908, the Greenwich and Kew lists, while differing in details, agreed in putting 39 per cent. of all the days in class "0," $58\frac{1}{2}$ per cent. in class "1," and $2\frac{1}{2}$ per cent. in class "2." No day practically is absolutely quiet, and a good many days are so near the line of demarcation of classes "0" and "1" that it is a good deal a matter of chance to which they are assigned. Again, there are an appreciable number of days so near the common margin of classes "1" and "2" that they may well be assigned to either. Thus while the Kew and Greenwich lists for the three years mentioned each assigned twenty-nine days to class "2," only nineteen days were common to both lists. If, then, a day is chosen by haphazard, it is most likely to be of disturbance class "1," while the odds against its being of class "2" are not so great that if it should prove to be of that class one is compelled to accept the coincidence as necessarily more than accidental.

In the present instance what was *a priori* the most probable event has happened; May 19 was undoubtedly of disturbance class "1." So far, indeed, as the declination curve was concerned, the choice between classes "0" and "1" was not very clear, but the horizontal force curve—while very far from being *highly* disturbed—was unquestionably up to the average class "1" level. The most rapid horizontal force changes occurred between 10 a.m. and noon, the range of the largest oscillation being about 50γ (0·0005 C.G.S.). There were also changes of nearly the same size between 0 and 2 a.m., and again between 3 and 5 p.m. The largest irregular declination movements occurred between 0 and 3 a.m., the range being about 9′. Later in the day there were some oscillatory declination movements synchronous with those shown in the horizontal force curve, but their amplitude was only 2′ or 3′.

As a rule, days of class "0" and days of class "1" disturbance occur in groups. The present occasion follows the general rule. From May 13 to 20 no day, except possibly May 16, was of class "0," May 13 being the most disturbed. There were horizontal force changes on the afternoons of May 17 and 18 similar in size to those on May 19. The afternoon of May 20 was also disturbed, though less so. The disturbances on May 18 and 19 were similar in magnitude to those which in 1902–3 accompanied what Prof. Birkeland termed "polar elementary" magnetic storms in the Arctic, and if Prof. Birkeland expected no more than a "polar elementary" storm from the passage of Halley's comet, then I have little doubt that the special observations he has been making in the Arctic will have supplied him with what he was looking for.

As it was conceivable that the intrusion of a comet's tail into the earth's atmosphere might exert a visible effect on the electric potential, I have also examined the Kew electrograms. The electrograms from May 19 to May 20

were throughout their greater part of the usual fair weather type, the potential being neither specially high, specially low, nor specially variable. There were, however, two intervals, between 8.40 and 9.20 p.m. on May 19, and between 1.30 and 3 a.m. on May 20, when there were rapid oscillations and negative potentials, which were not accompanied—as is usually the case—by a rainfall visible in the rain-gauge curves. Thunderstorms were, however, in active progress at the time at no great distance, a good many peals of thunder being audible in Richmond; there was thus nothing in the electrical phenomena that is not adequately accounted for by the observed meteorological conditions.

C. CHREE.

May 21.

The Magic Square of Sixteen Cells. A New and Completely General Formula.

THE ancient problem: *To construct a Magic Square with sixteen consecutive integers*, may be regarded as a special case of the general problem: *To construct a Magic Square with any sixteen positive integers, no two of which shall be identical.* The solution of the problem thus generally enunciated throws much new light upon the ancient special one, and will, in fact, enable us to classify and tabulate its 880 known solutions (8×880, if we admit reversals and reflections of the same square to be "different") much more scientifically than has hitherto been done.

The following is the completely general formula for the Magic of Sixteen Cells:—

$A-a$	$C+a+c$	$B+b-c$	$D-b$
$D+a-d$	B	C	$A-a+d$
$C-b+d$	A	D	$B+b-d$
$B+b$	$D-a-c$	$A-b+c$	$C+a$

For (1) this formula obviously represents a Magic Square, since every row, every column, and both the central diagonals sum to $A+B+C+D$.

Also (2) it is a function of eight independent variables.

Let S be the sum of our sixteen unknown quantities; then the constant total of the square will $=S/4$. If three of the rows sum to $S/4$, the fourth row must do the same; similarly with the columns.

Hence only *eight* of the ten given conditions are independent; we have to solve eight simultaneous linear equations involving sixteen unknown quantities. The solution, if general, must thus involve eight arbitrary constants. Therefore the above solution, which does involve eight arbitrary constants, is a perfectly general one.

I proceed to a numerical example. If $A=10$, $B=12$, $C=8$, $D=5$, $a=8$, $b=-9$, $c=-10$, $d=2$, our formula gives us a Magic summing in every direction to 35:—

2	6	13	14
11	12	8	4
19	10	5	1
3	7	9	16

It will be noticed that the number 19 is used, and the number 15 is not.

We have here an example of a Magic in its simplest form, with none of the superfluous (accidental) relations such as appear among the components when those numbers happen to be consecutive; and we see that the "complementary pairs" (each summing to half the constant total) upon which previous writers have laid such stress are a purely adventitious feature, and have no real connection with the laws of construction of the square.

In the fourth volume of the "Récréations Mathématiques" of Edouard Lucas (Paris, 1894) are set out three theorems and three corollaries, enunciating various equalities which must exist between the component numbers of every Magic of Sixteen Cells. The proof of these takes up four pages and a half, and requires twelve illustrative diagrams. My formula proves them all by simple inspection.

If, in the formula, $a=b$, the square assumes the type which Frénicle designated by the letter δ.[1] If $a=-b$, it assumes the type which Frénicle, in his table, left unmarked. Of the latter type, there are exactly 120 in consecutive numbers. I append an example of each type:—

δ

1	12	13	8
16	9	4	5
2	7	14	11
15	6	3	10

($A=7$; $B=9$; $C=4$; $D=14$; $a=6$; $b=6$; $c=2$; $d=4$.)

1	9	16	8
7	15	10	2
14	4	5	11
12	6	3	13

($A=4$; $B=15$; $C=10$; $D=5$; $a=3$; $b=-3$; $c=-4$; $d=1$.)

It must be borne in mind, however, that a complete numerical solution of the δ type necessarily includes the squares which Frénicle marked α and β, because both of these are, algebraically, particular cases of the δ form.

My formula readily supplies an infinity of solutions of the problem, *To construct a Magic Square with sixteen different prime numbers.* The following example (first published by me in the *Pall Mall Gazette* of February 26 last) omits two only out of the first eighteen odd primes, and sums to a far smaller constant than any other investigator has been able to obtain:—

1	47	13	53
61	17	31	5
29	7	59	19
23	43	11	37

($A=7$; $B=17$; $C=31$; $D=59$; $a=6$; $b=6$; $c=10$; $d=4$.)

It is obvious that every 4^2 Magic formed by the addition of two Latin squares is divided into equal quarters. No proof, however, has up to now been given of the "converse" of this proposition. I will deduce the theorem from my general formula.

Theorem.—Every 4^2 Magic in equal quarters can be expressed as the sum of two Latin squares.

That the form of the result may be more convenient, I

[1] "Ouvrages de Mathématique." Par M. Frénicle. (La Haye, 1731.)

re-state my general formula, with interchanged letters, as below:—

$A+d$	$C-a-d$	$B+a-b$	$D+b$
$D+c-d$	B	C	$A-c+d$
$C+b-c$	A	D	$B-b+c$
$B-b$	$D+a+d$	$A-a+b$	$C-d$

The condition that each quarter shall be equal to $A+B+C+D$ is obviously $a-c+d=0$. Substituting $-a+c$ for d, the universal formula for a *square in equal quarters* is therefore:—

$A-a+c$	$C-c$	$B+a-b$	$D+b$
$D+a$	B	C	$A-a$
$C+b-c$	A	D	$B-b+c$
$B-b$	$D+c$	$A-a+b$	$C+a-c$

which, by putting $A+a$, $B+b$, $C+c$, for A, B, C, respectively, becomes:—

$A+c$	C	$B+a$	$D+b$
$D+a$	$B+b$	$C+c$	A
$C+b$	$A+a$	D	$B+c$
B	$D+c$	$A+b$	$C+a$

This is the familiar traditional form, being the addition of one Latin square (A, B, C, D) to another (o, a, b, c). It is usually written (inaccurately) as if it involved eight arbitrary variables, instead of seven.

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Magnetic Deflection of β Rays.

THE nature of the emission of α rays from radio-active bodies, and the mechanism of their absorption when passing through matter, are well known from the experiments of Rutherford, Bragg, and others.

As regards β rays, our knowledge is not so complete. Although in recent years a large number of experiments have been undertaken in order to study the laws of their absorption, there still remains considerable doubt concerning several fundamental points. From the study of the absorption of β rays emitted from different radio-active substances, Otto Hahn and Lise Meitner arrived at the conclusion that the β rays, in the same way as α rays, are characterised by a definite initial velocity of expulsion. For different β-ray products the velocity may, of course, be different, but for a simple substance this velocity is characteristic of the rays. It was assumed by Hahn and Meitner that a homogeneous substance could be recognised as such by the exponential law of absorption by aluminium of the β rays which are emitted.

The experiments of W. Wilson were not in accord with this hypothesis. He found that the exponential law is not a measure of the homogeneity of the radiation, but, on the contrary, that homogeneous rays are absorbed according to a linear law.

In addition, the experiments of Kaufmann and Bucherer, who obtained a continuous magnetic spectrum of β rays in their determination of e/m and v for those rays, appeared to be contrary to the view of Hahn and Meitner. Such a spectrum could not be obtained on the assumption of groups of homogeneous β rays.

During the last few months the authors have investigated by a photographic method the magnetic deflection of β rays, and were able to show that in some cases very well-defined lines of deflection can be obtained. Experiments were especially successful when the active deposit from thorium served as source of radiation. As Hahn and Meitner have shown, this contains two groups of β rays (ThA and ThD). The authors obtained in this case two distinctly separated lines in the magnetic field. The line due to thorium A, which was further deflected, was nearly as well defined as if it were produced by α rays. Of course, by use of a stronger field, a third line, fairly well marked, was absorbed very near the ThA line, the source of which we are not yet quite certain.

But it is of interest that Hahn and Meitner recently discovered a new easily absorbed β radiation in ThX, and that the photographic impression, when using thorium X, really gave one more line as when using the active deposit alone.

Mesothorium gave a number of well-separated lines (about five or six). In this case the absorption experiments of Hahn and Meitner had already indicated a complex β radiation.

In the case of radium we have not, so far, been able to obtain single bands. This may perhaps be ascribed to the fact that the β rays from the radium products do not differ much in their velocities, and that the bands were consequently superposed, the intensity of the magnetic field being only about 80 Gauss. As a whole, the photographic impressions produced by the hard β rays are not very clear, since the rays pass through the photographic film without appreciable absorption, giving rise to a secondary radiation which fogs the plate.

The authors have proved by their experiments, at least for several of the radio-active elements, that these elements emit groups of β rays of definite velocity for which e/m and v can be separately determined.

A more detailed account of these experiments will be published elsewhere.

OTTO VON BAEYER.
OTTO HAHN.

Berlin, May 1.

Peripatus papuensis.

AT the end of last June I received from Mr. A. E. Pratt, the well-known naturalist, a number of fine specimens of Peripatus which he and his son, Mr. F. B. Pratt, had found in New Guinea on their recent expedition to that island. This is the first time Peripatus has been found in New Guinea. It was found by Dr. Willey in New Britain in 1897, and by Mr. Muir and Mr. Kershaw in Ceram last year (see NATURE, July 1, 1909, p. 17, and *Quarterly Journal of Microscopical Science*, liii., 1909, p. 737). The New Guinea specimens were found in January, February, and March at Sarayu, at an elevation of 3500 feet in the Central Arfak Mountains. Mr. Pratt, in describing his discovery, writes as follows:—"After my son found the first specimen amongst the roots of the grass, we at once showed it to the natives, offering them a large knife (which is most valuable to them) for every specimen. Quite sixty of the natives were searching for

the above months, and you have the results; so evidently they are not common in the part we were in. The curious thing is that, although we searched for weeks, we never found another specimen. The natives told me they found them at the roots of grass, under stones, and at the damp roots of clumps of bamboo."

Until the Ceram species was described it was quite uncertain whether the Papuan species would, when discovered, be found to belong to the Australian type or to the New Britain type, or to neither. Messrs. Muir and Kershaw's discovery settled that point. As a result of their work we know that *Peripatus ceramensis* belongs to the group Melano-Peripatus. It was therefore to be expected that the Papuan species would belong to the same type, as indeed it does. I propose to name the species *papuensis*, with the following characters:—

Peripatus papuensis, n.sp. Colour very similar to that of Capo-Peripatus, the principal pigments being a greenish-blue and an orange. Number of legs is variable, from twenty-three to twenty-nine pairs. Legs with three spinous pads. Nephridial openings of legs four and five on the proximal pad. Feet with three distal papillæ, of which one is anterior, one posterior, and one dorsal. Genital opening subterminal behind the legs of the last pair. Ovary small, with small ova (size not determined). Oviduct with a receptaculum seminis. Uterine embryos of very different ages in the same uterus. Spirit specimens which have been killed extended reach a length of $3\frac{1}{4}$ inches.

From this it seems fairly clear that we are dealing with a Melano-Peripatus. As the specimens are admirably preserved I hope soon to be able to work out the other characters. A. SEDGWICK.

Imperial College of Science and Technology, May 13.

The Bibliography of the Biology of the European Seas.

MAY I through the columns of NATURE direct attention to the fact that the Bureau of British Marine Biology, which for some time past has been engaged in the preparation of an extensive MS. bibliography of the fauna and flora of the European seas, is now making the experiment of printing and circulating, in the form of a periodical, the records which are thus being brought together?

The number of scientific journals has increased so enormously of late, and the output of biological work has now become so vast, that there would seem to be a very real need of some means by which the student may keep more fully in touch with the published work of his colleagues than is possible with the aid of the existing bibliographies alone; it has already become quite impossible for the specialist to himself search through all the various journals, &c., as they appear (even should he be fortunate enough to have access to adequate libraries), and, at the same time, to accomplish any research work of his own.

The bibliography of European marine biology now in progress (the first part was published on April 2) in the "Contributions from the Bureau of British Marine Biology" aims at providing a full title-entry and summary of the contents of every publication as it appears which is in any way concerned with the biology of the European seas (including the North Atlantic, Arctic, and Mediterranean). These summaries will, in general, appear *within a few weeks* of the publication of the works to which reference is made, while entries in the existing annual bibliographies are, of course, necessarily at least one or two years behindhand. The analysis of works indexed by the Bureau is also carried very much further than is attempted in any existing bibliography; for instance, a separate entry is made for practically *every mention* of a species in the work analysed. In addition to the bibliography and analysis of current work, the MS. records of the Bureau also include extensive annotated lists of the marine fauna and flora, alphabetical reference lists of specific and sub-specific names and synonyms, particulars of type-localities, type-specimens, &c.; it is likewise intended to publish these records in the "Contributions." It may also be mentioned that all entries are being printed in such a form as will admit of their use as a card catalogue.

There is, of course, no desire to make a profit by the publication of these records, but, on the other hand, the Bureau cannot afford to incur any considerable financial loss by the undertaking, and the publication of the bibliography will therefore not be proceeded with for any length of time unless there is *by an early date* distinct evidence that sufficient support will be forthcoming to meet the cost of printing. For this reason I would urge all who may be willing to assist the undertaking to notify as soon as possible their intention of subscribing. The bibliography will, I am sure, prove most useful to those interested in any department of marine research if only publication can be continued for a sufficient period to enable the "Contributions" to become established. Full particulars, forms for subscription, &c., will be forwarded upon application to the undersigned. S. PACE.

6 Provost Road, Haverstock Hill, London, N.W., May 11.

An Improved Weight Dilatometer.

THE ordinary form of weight dilatometer is troublesome to dry and fill, and the filling takes much time. Air bubbles are removed with difficulty, and after cooling to a low temperature there is a risk of loss of mercury while weighing the dilatometer unless special precautions are taken.

To obviate these disadvantages the form of dilatometer here illustrated has been devised. The neck of the dilatometer is short and straight, and is enclosed in a cylindrical cup projecting a few centimetres above the neck, and sealed on to the body of the dilatometer.

To dry the bulb, the cup is fitted with a cork and a piece of tubing, and connected to the water-pump. By gently heating the bulb and exhausting, moisture is removed. In the second form (Fig. 2) air is drawn through the bulb by removing the clip and pad from the side tube.

FIG. 1.

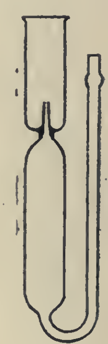


FIG. 2.

To fill the simpler form, Fig. 1, dry mercury is poured into the cup; by gently tapping, the mercury falls into the bulb. The operation is repeated until the bulb is filled. To remove air from the neck the dilatometer is warmed, and when the mercury oozes out the cup is re-filled, and the dilatometer placed in ice water above the level of the neck. After cooling, the excess of mercury is poured out of the cup. The dilatometer is dried and weighed, any mercury expelled by expansion being collected in the cup. After heating to a higher temperature, the expelled mercury is poured out, and the dilatometer weighed after cooling. In the form shown in Fig. 2 the filling is more rapid, as air is expelled through the side tube; when this is filled with mercury the clip is fixed, and the tube closed by a screw pad. A. V. C. FENBY.

The Wyggeston Boys' School, Leicester, May 11.

THE INTERNATIONAL ASSOCIATION OF ACADEMIES.

FOURTH MEETING, MAY 9–14.

IT is now ten years since the association was inaugurated in a preliminary meeting held at Wiesbaden, and since then regular triennial assemblies have taken place in Paris, London, Vienna, and finally in Rome, where the fourth meeting, conducted under the presidency of Prof. P. Blaserna, of the Accademia dei Lincei, has just come to a close. The representatives of the Royal Society were Sir Archibald Geikie, Sir Joseph Larmor, Prof. Schäfer, Colonel Prain, Prof. Turner, and Dr. Arthur Schuster. In judging of the past activity and the prospects of the association, it must be borne in mind that, having no funds at its disposal, its influence must be mainly

a moral one. It is intended to coordinate international enterprises, to initiate and encourage undertakings, and to act as an advisory body where advice is asked for, either by Governments or by the many special international organisations which have recently sprung up. The list of resolutions passed at each meeting may appear meagre to those who do not realise that they represent only the crystallised results of the discussions which have come to an issue, and that it often takes a considerable time before questions can be presented in a sufficiently definite form to admit of treatment by an international committee which can only meet at rare intervals; but those who have watched the proceedings of the association do not doubt that it has justified its existence, and that there is an important future before it.

That part of the association's work which prevents the overlapping of international enterprises has been illustrated in Rome by the manner in which the proposal of the Swedish Academy to take international action towards the prevention of the diseases of cultivated plants was dealt with. Everyone agreed that the subject was a most important one, and fell within the province of the association, but there is in Rome an International Agricultural Institute, which might be expected to include remedial measures against the diseases of plants within its range of activity. Apparently, however, there are difficulties which hitherto have prevented the Agricultural Institute from attacking the problem; these are partly financial, but partly also due to the terms of the convention under which the institute was founded. After a full discussion, the representative of the Swedish Academy accepted the following resolution, which was proposed by Colonel Prain, one of the representatives of the Royal Society:—

"The International Association of Academies of Science, while in entire sympathy with the proposal that further international cooperation in the study of plant diseases is necessary, considers that the question of deciding what ought to be done in the direction of combating these diseases might appropriately be entrusted to the International Agricultural Institute.

"In the event of its being found that the terms of the convention of 1905, under which it was established, prevent the International Institute from extending its activities so far as is desired in the interests of science and agriculture, this association recommends that the constituent academies bring to the notice of their respective Governments the desirability of conferring adequate powers upon the International Agricultural Institute."

A further question in which the association endeavoured to prevent a possible overlapping of enterprises arose out of the proposal to give the support of the association to an international committee formed to prepare tables of "physico-chemical" constants. Here a consultation with the International Scientific Catalogue Committee seemed advisable, and the following resolution was adopted:—

"The International Association of Academies gives its patronage to the International Committee of Physico-chemical Tables, and expresses the wish that this committee put itself into communication with the International Committee of the Catalogue of Scientific Literature."

The coordination of international scientific work which results from the extension of the patronage of the International Association of Academies to different independent enterprises is an effective method which deserves to be further extended. The International Union for the Study of Solar Phenomena has set a good example in this respect by asking the Association of Academies to nominate one of the three members of its executive committee. Prof. Riccò, of Catania, was nominated two years ago as the member representing the Accademia dei Lincei when that body became the leading academy, and he will hold office until the end of the year, when a new member will be nominated by the academy which will next act as host to the International Association.

The scientific questions which are dealt with by the association are frequently handed over to autonomous committees which regulate their own proceedings and act very much like independent international bodies. All that appears at the meetings is a short report summarising the activity of the committee. One of these committees deals with the investigation of the functions of the brain, and works under the chairmanship of Prof. Waldeyer, of Berlin. The work of a number of institutes specially endowed in different countries for the study of this question is thus coordinated, and a more rapid progress is secured.

A very useful piece of work has been undertaken at the instigation of the Royal Society, with the object of introducing order into the chaos which reigns at present in the nomenclature of prominent features on the surface of the moon. The advice of all astronomers interested in the subject has been obtained, and a committee has been formed, under the presidency, first of M. Loewy, and since his death of Prof. Turner. Maps of the moon are being drawn by Mr. Wesley from maps supplied by the Paris observatories, and the details of the nomenclature, according to a definite scheme agreed upon, will then be prepared by Messrs. Saunders and Franz.

Questions which are of importance in the general theory of terrestrial magnetism have been under the consideration of a special committee almost since the foundation of the association. The general magnetic survey of the ocean basins which is being carried out by the Carnegie Institution of Washington is expected to prove of fundamental importance in this respect, and the work of the committee is dormant at present, until that survey is more generally advanced.

The association has further interested itself in the publication of the collected works of Leibnitz, which is being promoted jointly by the Academies of Paris and Berlin, and in that of Euler's works, which has been undertaken by the Société helvétique des Sciences naturelles. The association has more especially approved at its recent meeting the decision to publish all memoirs in their original language. It may seem strange that such approval should be necessary, but it was called for by attempts that had been made to persuade the Swiss society to translate the Latin writings into a modern language.

A few words should perhaps be said on the literary side of the work of the association. The subjects dealt with included the preparation of an edition of the "Mahâbhârata," and of an "Encyclopædia of Islam," of Greek documents, and of a "Corpus Medicorum Antiquorum"; further, the very difficult question of an international exchange—by way of loan—of manuscripts belonging to public libraries.

That a young association should still have to devote a considerable part of its time to matters of organisation is not surprising, and there is one question which is likely to occupy its attention very seriously before a definite conclusion is reached. At present the association has no legal status, not being subject to the laws of any country. It cannot, therefore, accept any legacies, and it is rumoured that it has lost in consequence a very considerable sum of money. The simplest manner to overcome the difficulty would be to establish a domicile in some country, such as one of the smaller States of Europe. It is claimed by some that other advantages would accrue to the association if it had a definite home, and its business matters could no doubt be carried on in a more satis-

factory manner; but at present there is still too wide a divergence of opinion to render a definite proposal generally acceptable. In order to evade the difficulty at present preventing the association from having funds of its own, the committee of the association, at a meeting held last year, at which nearly all the academies were represented, passed a unanimous resolution recommending that the different academies should declare themselves ready to accept legacies or gifts to be held in trust by them for the purposes of the association. When this resolution came up for discussion at the present meeting, objections were raised by several delegates, and the matter had to be referred to the several academies for an authoritative expression of opinion. Doubts were expressed in several quarters whether it would be advisable for the association to be in possession of funds, and at any rate one delegate thought that it would be more powerful if satisfied with its present "moral" force. Time, further reflection, and the force of circumstances will no doubt lead to a generally acceptable solution.

By the admission of the Société helvétique des Sciences naturalles, which was decided upon almost unanimously, the association has established the important, and, I believe, wise, principle that it attaches greater importance to the representation of countries in which important work is being done and of societies which take a leading part in such work than to the more or less exclusive tests of membership which a society may adopt. The Swiss society is not an academy in the old and perhaps proper sense. It may be the poorer for having no mediæval traditions, but it is the richer for not having adopted, without such traditions, a mediæval organisation.

Our association now consists of twenty-one societies, and fears have been expressed that our work would become more difficult if the number were to be increased substantially. These fears are not, perhaps, groundless, if the addition of a new society does not mean the inclusion of new interests and of independent directions of activity. Now, if we look at the proper balance of representation of such independent scientific activity, it seems altogether anomalous that the British Empire should only be represented by the Royal Society and the British Academy. The non-representation of India more especially denotes a gap which should be filled without delay. Both on the literary and on the scientific side our work has dealt with matters in which India is directly concerned. The publication of the "Mahâbhârata," more especially, cannot be carried out without substantial help from India, and at the present meeting in Rome it was announced that several of the Indian native rulers have subscribed to the undertaking. In the Asiatic Society of Bengal, India possesses a society of full academic rank, and without it the International Association of Academies is not complete. Some formal changes in its organisation, the dropping of the word "Bengal" from its title (I understand that its inclusion was purely accidental and not originally intended), and an increased activity on the scientific side may be desirable, but even with its present organisation there is no reasonable doubt that a proposal coming from the Royal Society to add the Asiatic Society to the list of academies forming the union would be generally welcomed.

In his introductory speech, Prof. Blaserna made a feeling reference to the death of King Edward, and several of the festivities prepared in honour of the meeting were modified in consequence of the Court mourning. A state dinner which the King had intended to give was changed into a private reception of the delegates, and in place of a garden-party arranged for by Queen Margherita, the Queen entertained the delegates informally one afternoon at her palace. Soirées were given by the Syndics of the City of Rome in the Museo Capitolino, by Prince Teano and by Countess Lovatelli, but these were, as a matter of course, not attended by the British delegates. An interesting excursion by motor-car to Ostia, including a visit to the important excavations which are being carried out in that locality, concluded the meeting.

ARTHUR SCHUSTER.

HALLEY'S OBSERVATIONS ON HALLEY'S COMET, 1682.

IN the record-room at the Royal Observatory, Greenwich, are preserved nineteen manuscripts of Edmund Halley. In one of these, Halley's original observations of the comet afterwards called by his name were recently discovered by Messrs. Davidson and Burkett. The book is of about octavo size; it appears to have been originally a college notebook. On the cover Halley has written "Edmund Halley his Booke and he douth often in it Looke." Part of the book contains neatly written notes (in English) on geometrical conics, with carefully drawn figures, chiefly written on alternate pages. The observations (in Latin) and calculations have been jotted down subsequently wherever there is room, and in many cases have been written over the original contents of the book. By a strange coincidence (it can, I think, be no more than a coincidence) the observations, now identified as those of Halley's comet, are interspersed among notes on the parabola.

It will be recalled that Halley's researches which led to his discovery of the periodicity of this comet were not made until about twenty years after its appearance of 1682; in fact, the law of gravitation was not published until 1686. It is, however, well known that Halley saw the comet, but I believe that details have hitherto been lacking.

The observations now identified are given below in full, with practically no changes, except that punctuation has been added. In the original, symbols are used for the days of the week and the signs of the zodiac. The observations, which must have been made with the naked eye, are almost entirely alignments with stars; they are, of course, too rough to have any scientific value now, but are of historic interest. Calculations to determine the R.A. of the comet from these observations are intermingled with them. Although the observations can hardly be correct to 15′, six-figure logarithms are used in the calculations! Halley, however, did not use his own observations in his determination of the orbit of the comet. The references to the "hand," "foot," "knee," "pastoral staff," &c., of Boötes are of some interest as illustrating the early method of specifying stars, based on the Almagest.

The year is not given, but as the observations are certainly those of Halley's comet, and the days of the week agree, we may supply the date, 1682.

Saturday, August 26, 7h. 29′. Culminante 277° A.R., Cometa visus in linea recta cum Arcturo et capite Ophiuchi; et ex altera parte cum Corde Caroli et secunda caudæ Ursæ Majoris; vel linea recta a cometa ad 1am caudæ Ursæ Majoris relinquebat in consequentia stellam dictam Cor Caroli 30′ A.R.

Tuesday, August 29, 7h. 15′. Cometa in linea recta cum Arcturo et medium inter duas precedentes Coronæ, item in altera linea per Cor Caroli quæ relinquebat in conseq. stellam in radice caudæ Ursæ Majoris 30′; item in altera per genu præced. Bootis et medium inter contiguas dorsi; item in altera per genu sequens et med. inter 3am et 4am Serpentis. Ascent. Recta Cometæ 198° circiter.

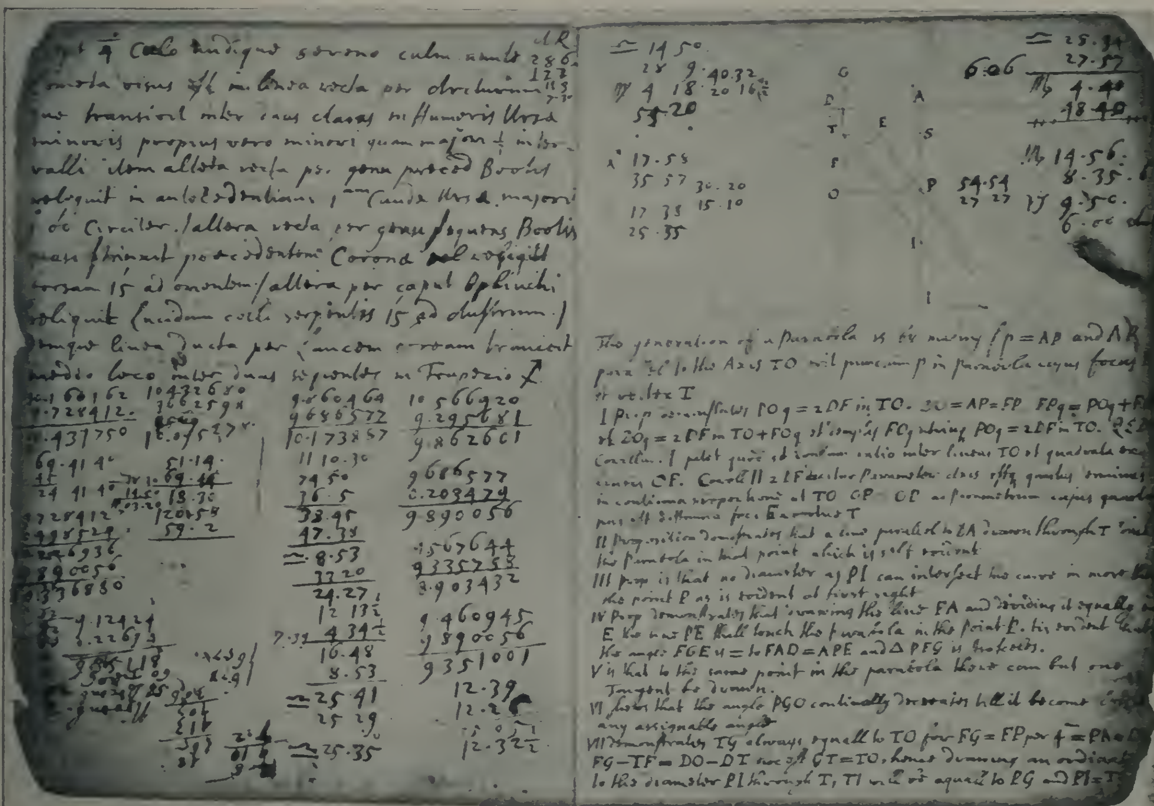
Wednesday, August 30. Culminante 280° A.R., visus est Cometa in linea recta quæ transiens genu præced.

Bootis relinquebat 15′ ad ortum [? orientem] stellam humeri præced. Bootis; altera recta ducta per Cometam et genu sequens Bootis transivit medio loco inter 2^am et 3^am Herculis; et parum forsam 20 minuta reliquerat rectam per Arcturum et 8^am. . . .

Thursday, August 31. Cometa in linea recta cum crure præced. Bootis et cubito sinistræ manus. Hinc nubes Horizonti vicinæ Cometam excepere.

September 4. Cælo undique sereno, culminante 286° A.R., Cometa visus est in linea per Arcturum quæ transivit inter duas claras in Humeris Ursæ Minoris propius vero minori quam majori ⅓ intervalli; item altera recta per genu præced. Bootis reliquit in antecedentiam 1^am caudæ Ursæ Majoris 1° 00′ circiter; altera recta per genu sequens Bootis quasi strinxit precedentem Coronæ vel reliquit forsam 15′ ad orientem; altera per caput Ophiuchi reliquit lucidem colli Serpentis 15′ ad clustrum; denique linea ducta per Lancem Boream transivit medio loco inter duas sequentes in Trapezio Sagittarii.

September 8. Jam statim occasurus, Cometa videbatur



Halley's original observations of his comet in 1682. The observations of September 4, 1682, with their reductions, occupy the left-hand page: the right-hand page contains notes on the parabola.

in linea recta ducta per Lancem Boream et medium cap. Sagittarii; itemque in altera per Arcturum, quæ reliquit in consequentiam præcedentem in manu Bootis 50′ circiter; videbatur estimatione Libra 29° 40′.

September 9. Eadem hora visus Cometa in linea recta per Lancem Boream quæ transivit grad. unum infra dextrum genu Ophiuchi; itemque in altera per crus sequens Bootis, quæ transivit medio loco inter superiorem colobori et caput Bootis; item linea ducta per Arcturum medio erat loco inter præced. manus Bootis et ult. caudæ Ursæ Majoris.

A page is torn out at the beginning of the book which may have contained observations prior to August 26. There is a note in Halley's handwriting on the inside of the cover, "August 16, primum visus ad initium Leonis," which evidently refers to this comet, but need not necessarily refer to his own observations. No record is made of an observation on September 10; but in Flamsteed's "Historiæ Cælestis" there is a note that it was seen through a gap in the clouds by Dr. Halley on this date, but could not be referred to stars, after which, on account of its nearness to the sun and increasing south declination, it was not seen again.

A. S. EDDINGTON,
(*For the Astronomer Royal*).

SOME NEW ORNITHOLOGICAL WORKS.[1]

(1) "THE Home-life of a Golden Eagle" is a valuable contribution to the history and psychology of birds. It reminds one of the daily entries in the hospital ward-schedule of an interesting maternity case, by the medical officer in charge, to whom, unseen, have been revealed instincts of mother and child which would never be displayed during the ordinary visitation. Mr. Macpherson is to be heartily congratulated on the completeness of his record, and on the dogged perseverance with which

[1] (1) "The Home-life of a Golden Eagle." Photographed and Described by H. B. Macpherson. Pp. 45+32 mounted plates. (London: Witherby and Co., 1909.)

(2) Bulletin of the British Ornithologists' Club. Edited by W. R. Ogilvie-Grant. Vol. xxiv., Report on the Immigrants of Summer Residents in the Spring of 1908; also Notes on the Migratory Movements and Records received from Lighthouses and Light-vessels during the Autumn of 1907. By the Committee appointed by the British Ornithologists' Club. (London: Witherby and Co., 1909.)

(3) "Catalogue of Canadian Birds." By John Macoun and James M. Macoun. Pp. viii+761+xviii. (Ottawa: Government Printing Bureau, 1909.)

(4) "The Birds of the Leeward Islands. Caribbean Sea." By C. B. Cory. (Chicago: Field Museum of Natural History, 1909.)

(5) "Birds of Illinois and Wisconsin." By C. B. Cory. (Chicago: Field Museum of Natural History, 1909.)

he carried out his observations under weather conditions of the most trying and discouraging sort. Wind, rain, sleet, and intense cold companioned him throughout the—"unbrokenly wet and gloomy"—period of investigation—from April to July.

The eyrie where this royal mother established her nursery was situated on a narrow ledge of rock, 200 feet perpendicularly above a stream "in a dark gloomy corrie in a wild deer forest"—which, with excellent circumspection, the author does not more definitely locate—"in the heart of the Grampian range," into which "the sun penetrates for a few short hours during the long summer day." Here, with the aid of a very sympathetic stalker, the recorder constructed, within a few yards of the nest, a "bothy" as an observatory, so well disguised that it deceived the "eagle eyes" of the parents—into which he could just crowd himself and his desire to read this diary for himself in its entirety, unspoiled by disjointed quotations. He will follow with unflagging interest the mother eagle sheltering her downy chick; feeding him at regular hours during its tenderest days; comforting him with wonderful solicitude on the approach of a violent thunderstorm; teaching him—when about a month old—how to feed himself for the first time. The diverting manœuvres of the youngster, his games with himself, and his toilet operations as he grows older are interestingly recorded; how, also, after eight weeks old, when nearly as big as his parent, he began practising exercises by which he acquired strength in his wings and legs, and, in addition, a fierce hunger and vigorous appetite, which demanded a daily ration of two grouse, and the hindquarters of two full-grown hares; and, finally, how, under his mother's instruction, his tuition in aviation, which, every day, was

Father and Child. From "The Home-life of a Golden Eagle."

cameras. From April 23, 1909, when the mother eagle was found sitting hard on two eggs, to the end of July, eleven weeks in all, we are made partakers, with Mr. Macpherson, of the most intimate privacy of the home-life of a member of a very exclusive set of bird society, and see every domestic incident performed naturally, and not through fear or suspicion, or under the distraction of an intruder. We feel, therefore, at the close of our vigils, that there is little we do not know about the upbringing of a prince of the avian blood royal, and the parental care and solicitude of the hen-eagle towards her offspring. About May 13 two eaglets were hatched; but one having mysteriously disappeared, the fortunes of its brother alone form the burden of this history.

It would be unfair to the author to extract, as one is tempted to do, the more intimate and touching episodes from his well-told story. Every ornithologist will

preparing him by short flights for his fast approachin[g] supreme adventure, when he must fare forth for th[e] first time into space "on his own." Mr. Macpherso[n] must allow us to quote his own account of the eaglet'[s] last hours in the eyrie:—

"At length he stepped forward to the edge of th[e] cliff and gazed intently upwards, at the same tim[e] uttering the low cheeping note with which he ha[d] always greeted his parents' return. . . . Then su[d]denly a dark form flashed up the corrie and h[is] mother swung past on silent wings . . . and tried t[o] tempt him from his fastness. But the Eaglet wa[s] unwilling to obey. . . . Again and again she hovere[d] round, then a wild, weird cry rang echoing down th[e] glen. For the first time I had heard the yelp of th[e] adult Eagle, the voice of the Queen of Birds callin[g] to her young. . . . The Eaglet cheeped continuous[ly] till . . . he flapped to the very edge of the abyss . .

listening to her call. And now he, too, changed his cry, his voice seemed to break, and the adult yelp . . . burst from his throat. The Eagles called to each other, yelp answered yelp. . . . The young Eagle gazed around him . . . spread out his giant wings and vanished for ever from my sight among the ledges below. . . . The Eaglet had left the nest and had flown."

This record is illustrated by thirty-two beautifully clear plates, reproduced from the author's photographs, which are splendid achievements when the difficulties of the situation and of the weather are considered. In them the eaglet's history is depicted from the egg to the day when it takes flight from the nest. Plate 18, "Father and Child" (Fig. 1), is here reproduced by courtesy of the publishers as a specimen of the series, every one of which is worthy of the ornithologist's careful study.

(2) This is the fourth report of the Migration Committee of the British Ornithologists' Club, appointed in November, 1904, for the purpose of collecting and collating evidence regarding the arrival and dispersal within England and Wales of some thirty strictly migratory species which winter abroad and nest within these limits. These reports are based on the records supplied by voluntary observers on land and on off-shore lightships and lighthouses, who have filled up and returned to the committee schedules of questions issued to them. Each report deals with the spring immigration and the chief autumn movements of the scheduled birds, the one under notice being for the autumn of 1907 and the spring of 1908. It opens with a summary of the weather reports from March to May, 1908, the period covering the spring immigration. The second section details the chief movements observed at the lights during the same period, and indicates the moon's phase and the direction of the wind on each occasion. Next are discussed the schedules of the thirty-three species, individually, each accompanied by a map, on which are plotted the more important data of their arrival and dispersion. Supplementary to this, the main and important portion of the report, are recorded observations on birds not specially scheduled. The migratory movements of the autumn of 1907 are then dealt with, but we regret to find no meteorological notes associated with this section, in which the weather conditions have a special bearing on the causes which impel the birds to start on their autumn journey southwards. A statement of the days and nights on which migration was recorded at the lights between Spurn Head and the Bristol Channel during the autumn of 1907, and a list of the observers close the volume.

The report calls for little at this stage in the way of discussion, as it is not a final digest, but a further instalment of data towards the elucidation of the great mystery of bird-life, compiled with great care and labour, for which ornithologists generally will desire to offer their grateful thanks to the committee. Nor is there much in its contents deserving of criticism, except, perhaps, to direct the editor's attention to the rather irritating omission from the maps of the elucidatory legends which appeared on those of some of the earlier reports, especially as no explanation is given in the text of the various symbols employed in any of the maps in the report under review. In the two maps devoted to the "swallow," in the first report, for instance, we find that a date within a circle was employed as the symbol for "2nd migration" on the one map, as well as for "5th migration" on the other; while on that for "the nightjar" it stands for "main migration." In other maps the "5th migration" is represented by the date within a triangle. It would be a great advantage if in every map the same symbols were used to indicate the same migration. Failing this, those used in each map should be printed upon it. On the map devoted to the blackcap in this report (p. 74), we find circles, squares, ellipses, and parallelograms, with no explanation of their import, the sole legend being "M = May; all other dates are in April." Further, on consulting the letterpress of the schedule for the same bird (p. 75) we read, "the earliest arrivals were reported from Gloucestershire on the 10th, 14th, and 21st of March, and these were followed by a pair in Devonshire on the 28th"; yet on referring to its map we discover no entry for any of these dates in the shires named; nor is the bird's earliest appearance in Wiltshire, on April 6, indicated on it, yet that of the 13th is entered, although it is stated in both cases that "the great proportion of the records were of single birds." Again, the same species is noted at St. Catherine's light on April 10 and 11, and the date is plotted on the map unenclosed by a line; its occurrences for April 27–30 are surrounded by an ellipse, while the dates of birds arriving four days later are enclosed in a parallelogram; yet the two records can hardly, we imagine, be assigned to a separate migration. Without, therefore, a legend or explanations in the text it is difficult to follow comfortably the map entries, the plotting of which must cost much in time and in money. Indeed, it may be a matter for consideration whether, at this preliminary stage of the inquiry, they might not be dispensed with, without much loss, seeing that the "chronological summary" under each species supplies all, and more than, they do.

The time is yet far distant when a digest of the valuable records in this report and its three predecessors can be attempted. It does seem, however, that, unless simultaneous observations can be taken over a far wider area than a portion of the British Isles, the true solution of the intricate and baffling problem of migration will not be greatly advanced. Besides ascertaining the flight-lines of the birds arriving in or departing from England and Wales, the state of the weather and the abundance or scarcity of food at these periods, we want to discover whence the individual birds that reach us in spring started; where those that nest within our shores in autumn actually spend our winter; why they adopt the particular routes they do; why they hasten to "change their skies" now to the north, now to the south; if the same individuals and their young invariably follow the same route in going and returning; and if they and their young drop out of the migrating flock every year at the same places in order to "build and brood in their old haunts." The pressing need in the migration inquiry is for the systematic marking in very large numbers, not only of nestlings, but of old birds, in this country and on the Continent of Europe, during both the summer and the winter visitation, but also, which is equally important, of those that spend our winter in southern latitudes, and at various halting places of the ranges of the species from furthest north to furthest south, in the Asiatic, Euro-African, and the American continents.

If the mark attached to the birds were a small facetted ring of aluminium, a light metal which long retains its brilliancy, it would often attract the eye by flashing in the sun, and thereby many birds would be detected as marked individuals by interested or chance observers on the look out for them, in districts especially where such labelling was known to have taken place. The birds could then be followed up, temporarily captured for their mark to be recorded, and then liberated, and the record thereafter promptly published. Until some such united action and extended system for identifying the movements

of individual birds—their actual routes of travel, their retreat during our winter, and their home in our spring and summer—is adopted, there appears little hope of our ignorance of the mystery of migration being quickly or greatly dissipated. We suggest this subject for consideration at the approaching International Ornithological Congress in Berlin.

(3) The "Catalogue of Canadian Birds," by the Macouns, father and son, is an endeavour, successfully carried out, "to bring together facts on the range and nesting habits of all birds known to reside in, migrate to or visit the northern part of the continent," including Newfoundland, Greenland, and Alaska. The authors enumerate 768 species as the avifauna of the region indicated. There is a full account of the distribution, nesting habits, and migration of each species, with many interesting notes on their habits and life-history. An introductory note by the director states that the present volume is an enlarged and to a great extent re-written edition of a previous catalogue, in three parts, which became exhausted immediately after publication. This is excellent evidence, not only of the interest taken by the public in the birds of their own country, but of the value to ornithologists generally of the work, for which we have nothing but commendation—except to say that it deserves a better binding—and to express the hope that the same fortune may be in store for the present edition which attended its predecessor.

(4 and 5) These two volumes belong to the series of publications being issued by the Field Museum of Natural History in Chicago. Both are by Mr. C. B. Cory, the curator of the Department of Zoology. The first of these, on "The Birds of the Leeward Islands," enumerates all the species inhabiting Aruba, Curaçoa, Bonaire, Islas de Aves, Los Roques, Orchilla, Tortuga, Blanquilla, Los Hermanos, the Testigos, and Margarita. The collections were chiefly made by Mr. J. F. Ferry and Dr. N. Dearborn. Each island is dealt with separately, the list of birds from each being prefaced by a short account of the island and a list of its ornithological literature. Dr. Hartert, now of Tring, had previously visited the larger islands of the group, and has described in detail their avifauna in the Hon. Walter Rothschild's *Novitates Zoologicae*, and in the *Ibis*, so that in few of them were there many novelties to be expected. Nevertheless, five new species and three new subspecies were discovered, chiefly on the smaller islets which Mr. Cory's energetic collectors were the first to visit.

Mr. Cory's second book is a much more pretentious volume, and includes, "as far as known, all species and subspecies of birds that occur in Illinois and Wisconsin," the total number being 365 (not 398, as stated in the preface), with descriptions of their various plumages, nests, and eggs, and geographical distribution, together with more or less brief biographical notes concerning them. It is more, however, than an avifauna; it is, in addition, an ornithology for less advanced students. The book is divided into two parts, the first devoted to a key to the families and species, and the second to biographical notes on the species. No fewer than 274 pages are given to the key, which is constructed on a series of highly artificial characters. In the first place, the birds are divided into two great divisions—water birds and land birds. In the former, Mr. Cory includes landrails, herons, golden plovers, and peewits (because they may sometimes be found feeding near water!); yet ospreys, sea-eagles, and kingfishers, which find their food chiefly in that element, are classed as land birds. The collector with a bird in his hand must first decide whether it is a land or a water species, and, having determined this (not, perhaps, as Mr. Cory would), he must, in order to run down the family, enter tables prepared for him according to the length of the wing. "A large series of specimens has shown," says Mr. Cory, "that while adult birds of the same species differ considerably in length, the wing measure is very constant." Recent investigations have, however, showed this statement to be far from true. Wings vary greatly, not only in actual length in different individuals of the same species, but the wing feathers, the primaries, for instance, vary in length in different proportions. Even Mr. Cory's tables show this. The species *Passerherbulus* (!) *caudacutus nelsoni* is to be found in a group with wings from 1·75–2·5 inches; also in a second, with wings from 2·15–2·37 inches long, as well as in a third, with wings from 2·37–2·75 inches! Examples of the same sort are numerous. Another species appears in one group as having "belly clear yellow" in a second with "underfronts yellow or greenish yellow," and in a third with "under-parts pale greenish yellow."

A curious error occurs on p. 114, where an illustration entitled "first *five* primaries emarginate Bald eagle," is drawn with *six* primaries! The author here adheres also to a method of enumerating the primary quills which has long been given up by all modern ornithologists, who number these feathers from the carpal-joint outwards, and not from the point of the wing inwards.

The second and really valuable portion of the work deals with the history of the 365 species found in the two States, in which the very numerous (and excellent, be it said) illustrations appearing in the key are all needlessly repeated, thus adding greatly to the cost and to the bulk of the book. The volume is beautifully printed on a fine-surfaced paper, and is worthy of a better binding than the flimsy paper covers in which it is issued; but it would be greatly improved by having the system of keys to the families and species remodelled and much condensed.

PORTUGUESE ZAMBEZIA.[1]

FOR the pictures alone this book is worth purchasing. We have rarely seen in any similar work dealing with Africa a better collection of admirable photographs which are apt illustrations of the text. The book is not written round the illustrations, nor are these photographs stuck into the work without relation to its text and purport. If Mr. Maugham had further confined himself in his text to his own personal observations of this relatively vast region of Portuguese Zambezia, and to his own theories based on his personal observations and experience, there would be nothing in the book to criticise unfavourably. But he has conceived it necessary to borrow largely from the works of other writers, borrowing which he frankly acknowledges in the preface, but which, one might plead, were quite unnecessary to his purpose in view.

Somehow or other, a mischievous idea has spread amongst many writers on Africa of late years that it is not sufficient for them to relate their own experiences and to describe a portion of the country they have visited, but that their work must make an attempt at being encyclopædic. If they write as historians of their own personal researches, then they feel obliged to give summaries of linguistics, natural history in general, or botany, which they extract from already published works, and again set forth either

[1] "Zambezia: a General Description of the Valley of the Zambezi River from its Delta to the River Aroangwa, with its History, Agriculture, Flora, Fauna, and Ethnography." By R. C. F. Maugham. Pp. xiv+408; with maps and illustrations. (London: John Murray, 1910.) Price 15s. net.

as due to their own original research, or, quite fairly (as does Mr. Maugham), as the work and conclusions of other people. But in this transposition, not having sufficient technical knowledge, perhaps, they allow themselves or their printers to mar these summaries with ridiculous mistakes in names, English or Latin, or they repeat the few errors of the persons from whom they borrow. Mr. Maugham does more. He adds a little acid to his work by recounting the theories of his predecessors or fellow-travellers (and very often misinterpreting them in the repetition) and then holding them up to ridicule; while at the same time it is patent to a specialist that he has not taken the trouble to understand what appears to him absurd. I pointed out the same tendency in an earlier work of his, in which he chose—one does not know why—to ridicule theories of the origin of the Bantu languages set forth by English and German philologists, while by his own confession (and certainly by the evidence in his text) he was without special knowledge of the subject.

If it were not for this desire on his part to have a dig at all and sundry who have at one time or another written on the countries of South-East Africa, he would have given us a most agreeable, as well as a most interesting, book; for when he confines himself to his own researches and observations he arouses the interest of the reader and secures the adhesion and respect of those who know Africa as well as he does, or even better. The reader's attention should be directed to the author's sensible remarks on pp. 157–9, as to the proportions of the European hold over the southern half of Africa. These should be a corrective to any excessive exultation. In several directions also he renders service to the very few persons in the United Kingdom, and to the three or four individuals in the southern half of Africa, who are foolish enough to care for the preservation of big game and of interesting birds and beasts. He points out with absolute truth the nonsense of the theory that connects the spread of the Glossina tsetse-flies with the abundance of big game: the theory which is quoted by the officers of the British South Africa Company, and of other great companies controlling South Central Africa, and by the thousands of "sportsmen" now swarming over Africa and slaying everything right and left, as their justification for spurning game regulations and mocking at the attempts of a few "fanatics" who think that at any rate a selection of the big and interesting wild beasts might be preserved for the intelligent appreciation of later generations. He cites this example of the falsity of the theory.[1] There is a considerable region of desolate country lying between the west bank of the Shiré River and the north bank of the Zambezi up to the vicinity of Tete. In this district, across which passes the Cape-to-Cairo telegraph line, there are few human inhabitants, and there is absolutely no wild game. Yet here the tsetse swarms, as it does, possibly, nowhere else in Africa; in fact, its extraordinary abundance has driven away most of the human inhabitants because they have found it impossible to keep any form of domestic animal. Now, if this district swarmed with game, one would be justified in supposing that by destroying the game one might drive away the tsetse. But apparently the Glossina flies have made life unbearable for all creatures that do not fly or burrow in the ground, and yet they continue to swarm.

Zambezian Goldsmiths: and Huts built upon Piles. From "Zambezia."

Mr. Maugham, however, is not always consistent in his desire to create a little tolerance for the existence of beasts and birds, not as yet of interest to South African settlers or sportsmen. He says contemptuously that "the rhinoceros will have to go," but gives no justification for such an utterance. To the intellectual interests of the world the two forms of existing African rhinoceros are quite as important as (let us say) the moderate prosperity of a few European settlers.

But, of course, the only proper solution of this question in Zambezia, as well as elsewhere, is the marking off of game preserves which shall grow by degrees into national parks, and shall harbour and sustain the wild fauna. In the intervening regions the land must be given up to exploitation by man, black or white, and any game straying beyond the reserves should receive no protection. But, of course, the

[1] Further support is given to his remarks in the very interesting article on the flora and fauna of Ngamiland (by Major Lugard) just published in the Kew Bulletin and deserving special notice.

farce of the "reserve" system at present is, first, that the local white and black population do not obey the law, and the local authorities seldom enforce it, and second, that the Government is somewhat too ready to set aside the law in favour of distinguished sportsmen.

In no book which the reviewer has yet seen have the great beasts, the landscapes, and the people been more admirably photographed than in this work on Zambezia, while at the same time due justice is done to the Portuguese towns, the Portuguese officials, and generally to such civilisation as Portugal has been able to introduce into these lands.

H. H. Johnston.

PELLAGRA AND ITS CAUSE.

A GOOD deal of notice has been taken lately in medical journals and in the newspapers of the disease pellagra. It is difficult for British folk to realise the scourge this disease causes in many countries, but chiefly in Italy, Roumania, Spain, Tyrol, and other countries in south-eastern Europe. In the United States of America, pellagra has spread recently to an alarming extent, and in several British colonies and protectorates, markedly the West Indies and Egypt, pellagra is a serious ailment. Persons who contract the disease present a train of symptoms which may be summarised as follows:—"sunburning" of face, neck, chest, and hands is an early and very prevalent manifestation; stomachic and intestinal catarrh; feverishness; skin rash; lassitude and weakness. Spring and autumn recurrences continuing for years further tend to mental excitement and bodily weakness, leading all too frequently to lunacy and a fatal issue.

The disease has hitherto been attributed to eating damaged maize, which is so largely consumed as "polenta," the "porridge" of Italy. In the United States maize is termed Indian corn, and under various names it is used in many countries. In 1905 Dr. L. W. Sambon, at a meeting of the Tropical Section of the British Medical Association, criticised the accepted theory, pointing out that pellagra did not seem to be a food disease or due in any way to unsound maize, but that in all probability it was due to a parasite—a protozoon. Dr. Sambon supported his theory by arguments based upon the well-established priniciples applicable to protozoal infections, and put in a form which appealed to men of science. His theory gained adherents until it gradually came to be considered a duty to humanity and to science that the question should be fully inquired into. With this object in view, a Pellagra Investigation Committee was formed in London by Mr. James Cantlie, and Dr. Sambon was sent to Italy on March 20, 1910.

At present the field commission in Italy, consisting of Dr. Sambon and his assistants, is engaged in inquiring into the epidemiology of pellagra. Many pellagrous districts in northern Italy have been visited and the banks of the streams searched for possible carriers of the disease. The field commission has come to the conclusion that pellagra occurs amongst the cultivators and not amongst the consumers of maize; that it is the agricultural labourer, not the town dweller, who suffers from pellagra, and that it is whilst working in the field that the labourer becomes infected. In a telegram dated Rome, May 13, and published in the *Times*, May 14, Dr. Sambon states that it "has been definitely proved that maize is not the cause of pellagra." In addition the telegram assures us that "the parasitic conveyer is the *Simulium reptans*."

The Simulium is a species of fly commonly called "sandfly"; its larvæ are met with on the rocks an[d] stones along the streams in pellagrous countries, an[d] Dr. Sambon seems to connect this fly with the sprea[d] of pellagra.

So far as we know, Dr. Sambon has not found th[e] parasite, nor is there direct proof that the Simuliu[m] is the actual carrier. That he has found cause for th[e] statement that eating maize is not the cause of th[e] disease is highly probable, for several men of scienc[e] such as Babes (Roumania) and Alessandrini (Rome) have declared in favour of Sambon's theory, and hav[e] been working on the lines suggested by him for th[e] elucidation of pellagra. Even with the announcemen[t] above quoted, stating what work has been done, ther[e] is much yet to do. Questions of the kind are no[t] settled in a day, and it may take years of inquir[y] before we have finally settled what Dr. Sambon ha[s] so well begun.

The fact that it is a duty to humanity and t[o] science that pellagra should be investigated does no[t] provide the necessary money, and the committee i[n] London has endeavoured to keep the inquiry goin[g] by appealing to friends to help. So far some 245[l.] have been actually collected, and further sums have bee[n] guaranteed; but even should the Government favou[r] the work by contributing the 150*l.* which the con[-]mittee was led to believe might be the case, the su[m] is quite inadequate, and unless further donations ar[e] speedily to hand the field commission must be recalle[d] from Italy in a fortnight. Sir Lauder Brunton, Bart[.] is the chairman of the committee; Prof. F. M. Sand[with] vice-chairman; the bankers are the London an[d] South-Western Bank, Great Portland Street branch and donations may be sent to the treasurer, D[r.] Clement Godson, 82 Brook Street, W., or to M[r.] James Cantlie, 140 Harley Street, London, W[.] honorary secretary, Pellagra Investigation Committe[e].

NOTES.

For some time past a scheme for the distribution [of] time signals by wireless telegraphy has been mooted wit[h] the view of assisting navigation and for the determinatio[n] of longitude. The Eiffel Tower in Paris and the summ[it] of Teneriffe have been proposed as suitable sites for t[he] emission of these signals, and we now learn that the pla[n] for which M. Bouquet de la Grye and Commandant Guy[ou] are more especially responsible is so far complete that t[he] first signals were dispatched from the former station [at] midnight on May 23. The Paris correspondent of t[he] *Morning Post* states that Paris time was transmitted fro[m] the observatory by way of the Eiffel Tower by wirele[ss] telegraphy to all wireless stations and ships fitted wi[th] wireless apparatus within a radius of between 2500 a[nd] 3000 miles. The system is an automatic one, and a Mor[se] sign is sent into space first at midnight, again two minut[es] after midnight, and, finally, four minutes after mi[d]night. Thus, steamers furnished with wireless telegrap[h] apparatus will no doubt be placed in a more favoura[ble] position, but the suggestion that has been made in so[me] quarters, that chronometers can be dispensed with, seem[s] premature. The receipt of a signal will not enable [a] ship to determine its position or even its longitude. [All] it will do is to give the error of the chronometer. T[he] ship's officers will not be able to forgo the use of Sum[ner] lines and other devices, and for these the knowledge [of] local time and the use of a ship's chronometers will [be] convenient. It may be desirable to point out here wh[at] is the kind of error in longitude to which in these da[ys] of accurate navigation a ship is liable, or what is [...]

amount of error which the employment of telegraphic signals can correct. Of course, the error accumulates with the time at sea, but a ship that carries three chronometers, the usual number in a well-found ship, should not after 100 days be in doubt about the longitude by a greater quantity than twenty seconds; usually it is much less. At the equator this would amount to an uncertainty of about five miles, in the longitude of Paris correspondingly less: but the number of time signals scattered over the world is now so large that every steamer has the opportunity of correcting its chronometers much more frequently than is suggested here. While, therefore, we welcome every advance which increases accuracy and demonstrates the value of scientific application, we cannot consider that the practical benefits of the scheme will be immediately apparent.

Mr. J. B. Tyrrell has been elected president of the Canadian Institute, the oldest scientific society in Canada.

We regret to see the announcement of the death, on May 23, at eighty years of age, of Mr. J. B. N. Hennessey, F.R.S., late deputy surveyor-general in charge of the Trigonometrical Surveys, Survey of India.

In consequence of the death of King Edward, the council of the Institution of Civil Engineers has decided not to hold a conversazione this year. The eighteenth "James Forrest" lecture will be delivered at the institution on June 22, at 8 p.m., as already announced.

Prof. R. W. Wood, of the Johns Hopkins University, Baltimore, will spend the coming autumn, winter, and spring in England and on the Continent. He has accepted invitations to deliver the Thomas Young oration of the Optical Society and the Traill Taylor lecture before the Royal Photographic Society, and will arrive in London early in October.

On Tuesday next, May 31, Mr. C. J. Holmes will begin a course of two lectures at the Royal Institution on "Heredity in Tudor and Stuart Portraits"; on Thursday, June 2, Major Ronald Ross will deliver the first of two lectures on "Malaria"; and on Saturday, June 4, Prof. J. A. Fleming will commence a course of two lectures on "Electric Heating and Pyrometry" (the Tyndall lectures).

The King, on the recommendation of the Home Secretary, has approved of the reconstitution of the Royal Commission on Mines for the purpose of an inquiry into the health and safety of persons employed in metalliferous mines and quarries. The new commission will consist of Sir Henry Cunynghame, K.C.B. (chairman), Mr. R. A. S. Redmayne, Dr. J. S. Haldane, F.R.S., Mr. John S. Ainsworth, M.P., Mr. R. M. Greaves, Mr. R. Arthur Thomas, Mr. R. T. Jones, Mr. W. Lewney, and Mr. U. Lovett.

During the Whitsuntide excursion of the Geologists' Association to Swanage, Mr. John Newton obtained a well-preserved upper jaw of the small mammal Triconodon from the Lower Purbeck beds. The specimen was found in the fresh-water limestone above the well-known mammal-bed, which was carefully examined at two places in Durlstone Bay without success. It appears to be the first discovery of a mammalian fossil in the Purbeck beds since 1880, when Mr. Edgar Willett obtained the lower jaw of Triconodon now in the Museum of Practical Geology. Mr. Newton has placed the new fossil in the British Museum (Natural History), where it will be exhibited with the Beekles collection.

During the next few weeks the Somersetshire Archæological and Natural History Society will commence the excavation of the lake village at Meare, three miles north-west of Glastonbury. Besides interesting mediæval buildings, such as the Fish House and the Manor House, the parish contains the remains of a lake village much larger than that of Glastonbury. Trial excavations have already disclosed many interesting objects, and the thorough examination of the site will certainly prove to be of much importance in elucidating the history and antiquities of the late Celtic period, dating back a century or two before the Christian era. Assistance, which is much needed in support of the excavation fund, will be gladly received by the secretaries, Taunton Castle, Somerset.

The series of aëronautical calamities which figures so prominently in the issue of the *Deutsche Zeitschrift für Luftschiffahrt* for April 20 is continued in the issue for May 4, where the destruction of the *Zeppelin II.* at Weilburg, and that of the Delitzch balloon, which was struck by lightning on April 6, are described and figured. In addition, there are figures and references to accidents to Rougier's and Chavaz's machines at the Nice aviation meeting, the former having fallen into the sea and been picked up by a steamer.

M. Jacques de Lesseps, grandson of the engineer of the Suez Canal, crossed the English Channel on May 21 in a Blériot monoplane. Instead of a three-cylinder Anzani motor of 25 horse-power, such as was used by M. Blériot, M. de Lesseps employed a seven-cylinder Gnôme rotary engine of 50 horse-power. He started from Les Baraques, near Calais, at 3.40 p.m., and landed close to Wanston Court Farm, near St. Margaret's, at 4.17 p.m. According to the French Press, the crossing took thirty minutes, as compared with M. Blériot's thirty-one minutes' flight. M. de Lesseps reports that he travelled at a height of from 350 to 400 metres to avoid the fog, which obscured his view, and that he was unable to make use of a compass on account of the effect of the great vibration upon the instrument. By his successful flight M. de Lesseps wins the Ruinart prize of 500*l.* and the 100*l.* cup offered by the *Daily Mail* for the second airman to cross the Channel in the air.

In an article on the London to Manchester flight (Nature, May 5) reference was made to the desirability, now that the possibility of long-distance flights has been clearly demonstrated, of devising means for encouraging the pursuit of aviation without taxing the physical endurance of aviators or subjecting them to risks more than was necessary. From an article in the *Deutsche Zeitschrift für Luftschiffahrt* we gather that the arrangements made at the Nice aviation week afforded an excellent example of what could be done in this direction. In the first place, the long-distance flights were performed mainly over the sea between Cap Ferrat and Cap d'Antibes, where steamers were available (in the language of the *Zeitschrift*) to "fish out" any aviator who descended, and this actually happened to Latham; in the next place the prizes offered included a cumulative prize for the longest total distance covered, excluding individual flights of less than 5 kilometres, and prizes were also offered for the quickest flight performed on each day, the best start and the best landing, so that the chances of success were less dependent on meteorological conditions than they would have been if competitions at fixed hours had alone been provided for. That progress is being made in aërotechnics was shown by the fact that while at Berlin last year flights were only made when the wind velocity was less than 3 metres per

second, the anemometer at Nice often showed velocities of 7 to 10 metres per second without interfering with the flyers. It is interesting to note that the starting place was close to the mast where the late Captain Ferber made his early experiments. The writer also refers to the liberality of the citizens of Nice and others in contributing to the prize funds.

A spell of really warm weather occurred over the British Islands, and the weather report for the week ending May 21, issued by the Meteorological Office, shows that the shade temperature was everywhere above the normal, the mean for the period ranging from about 3° to 6° in excess of the average in different parts of the kingdom. The warmest district was the south-east of England, where the mean was 58°, and the absolutely highest temperature was 83°, at Hillington, in the east of England, on May 20. The lowest shade temperature anywhere was 37°, but slight frost occurred in the open in several places. The mean temperature of the sea was considerably higher than during the preceding week on many parts of the coast, and was generally higher than in the corresponding week of last year. The rainfall was mostly in excess of the average, and the aggregate measurement since the commencement of the year is largely in excess of the average, the excess being more than 3 inches in several of the northern and western districts. There was a good deal of sea fog and mist along the east and north-east coasts of Great Britain. Thunderstorms were very common in England, and rather so in Scotland and the south of Ireland. On May 20 and 21 they occurred over a wide area in Great Britain, and several persons were killed by lightning.

In our issue of December 2 last full particulars were given of the eighth International Zoological Congress which is to be held at Graz (Austria) on August 15–20 next, under the presidency of Prof. Ludwig von Graff. We have received a second circular in connection with the congress which gives much practical guidance to foreign visitors. It is pointed out that as the most direct route to Graz is *via* Vienna, many of the scientific institutions of that city have made arrangements to receive foreign visitors during August 12 and 13. Arrangements are being made to secure a reduction of fares on the Austrian railways. The circular also provides full details of the numerous excursions which have been arranged. We may remind zoologists that all inquiries relative to the congress should be sent to the Präsidium des VIII. Internationalen Zoologenkongresses Graz (Österreich) Universitätsplatz 2.

It is with great regret that we have to announce the death of M. Bernard Brunhes, the director of the observatory of the Puy de Dôme. M. Brunhes died at the early age of forty-seven, and had been in charge of the observatory for only the last nine years, but he brought to its administration a high reputation for capacity and industry, qualities which were recognised while a student at the Sorbonne, and had been further developed during his occupancy of important scientific positions both at Dijon and Clermont-Ferrand. Under his directorship the observatory won a prominent position for researches in the several departments of terrestrial magnetism, the physics of the earth's crust, and the exploration of the upper atmosphere. M. Brunhes will be particularly remembered for his researches in meteorology, in which mechanical contrivances could be employed to elucidate physical phenomena. With considerable ingenuity he discussed the mechanical action exerted by a horizontal current of air upon a whirlwind, having sinistrorsal and dextrorsal motion about a vertical axis susceptible of lateral displacement. Another subject which engaged his attention was the effect of a want of symmetry in the action of running water, as exhibited in the erosion effects upon opposite banks of rivers. His reputation must, however, rest mainly on the work of weather forecasting, to which purpose the activities of the observatory were chiefly directed. He held in scorn those who attempted forecasting without any knowledge of the general movement of the atmosphere, and on the occasion of the proposal of the sensational scheme for competition in weather forecasting, his denunciation of those who, to acquire a little brief notoriety, were willing to run the risk of bringing science into disrepute was both merited and timely. As a writer of scientific treatises intended to make science popular, he was exceedingly successful. In crystallography, terrestrial magnetism, and meteorology, his books have been welcomed as models of clearness and accuracy, while his latest work on "La dégradation de l'Énergie" has won a well-deserved approval.

The scientific side of geographical exploration has suffered a severe loss by the death of Lieut. Boyd Alexander, in the Sudan, at thirty-seven years of age. From information received at the Foreign Office it appears that Lieut. Alexander was killed at Nyeri, about seventy miles north-east of Abeshr, the capital of Wadai, on April 2, a few days before the French troops met and defeated the native bands opposed to the French occupation of the country. Lieut. Alexander began his career as a traveller-naturalist in 1897 by an expedition to the Cape Verde Islands, and in the following year he made expeditions to the Zambezi and Kafue Rivers. In 1904 he visited Fernando Po, and made some valuable ornithological observations. His most important work, however, was accomplished during the Alexander-Gosling expedition of 1904–7, which crossed the African continent from west to east. One of the objects of this expedition was to study the distribution of the fauna between the Niger and the Nile from the point of view of zoological relationships between the west coast region and the Nile basin. The expedition mapped a large area, made systematic observations of the natural history and ethnology of the region traversed, and secured collections of great value to science. For this achievement Lieut. Alexander was awarded the gold medal of the Royal Geographical Society. Toward the end of 1908 he left England for further zoological and geographical explorations, and was in the German Kamerun Colony during the great earthquake in that part of Africa about a year ago, and the subsequent eruption of the Kamerun Mountain. He then passed to the Lake Chad region, and at the time of his death appears to have been making his way to the Nile by the north of Wadai and Dafur. It is greatly to be deplored that this adventurous journey has deprived science of an explorer and naturalist of such great distinction and promise.

We learn from the *Builder* for May 21 that next year, in connection with her International Exhibition, Italy will inaugurate the great national monument to Victor Emmanuel, which has been a quarter of a century in building, and has cost an immense sum of money. By its importance, and, on the whole, by its artistic excellence, it is worthy of the patriot king. The breadth of the monument is 460 feet and its depth 480 feet. Standing on a spur of the Capitoline Hill, it is one of the most prominent objects in the City of Rome. On a lofty pedestal in the midst of a stately lay-out of steps and terraces stands the colossal equestrian statue of "il ré galant'uomo" by Enrico Chiaradia. It is approached from below by a stair 130 feet wide in four flights of convex plan, and as a background it has a gigantic

colonnade of concave plan backed by a wall parallel to it. At either end of this are square open halls decorated internally with coloured marbles, and supporting quadriga groups. Among the many works of sculpture by Italian artists is a fine series of statues personifying the provinces of Italy—Latium, Lombardy, Venetia, and so forth. The architect was Count Giuseppe Sacconi, who died in 1906 without having seen the completion of the monument.

IN the *Cairo Scientific Journal* for February Mr. Harold Sheridan gives an account of that curious musical instrument, the *rabába*, which was introduced into Europe by the Crusaders, and, with a slight modification of the original name, is now known as the rebeck. It has certainly been evolved from the one-stringed lyre of the early monuments, the single string twanged with the finger developing into the present double-stringed instrument played with a rude bow and provided with a body. Even in its present state it is a most primitive instrument, made up in the rudest way out of a long iron nail, a cocoa-nut, a few strands of horse-hair (that of the living animal being most in request), a piece of fish-skin, and sundry pieces of wood. The last are coarsely glued together, and the body is made of half the cocoa-nut, over which a piece of moist skin—that of the Nilotic fish known as the *bayad*—is tied tightly until it dries. The tone is regulated by incisions made in the body, those being most numerous when the tone is intended to be loud, and this is further regulated by moving the bridge. The *rabába* is thus of considerable interest as marking an early stage in the evolution of the modern violin.

A MEMOIR issued in the Eugenics Laboratory Series (Dulau and Co.), by Miss Ethel M. Elderton, assisted by Prof. Karl Pearson, discusses the influence of parental alcoholism on the physique and ability of the offspring. The memoir is based on two series of data, the one contained in a report of the Edinburgh Charity Organisation Society, the other in an unpublished report, by Miss M. Dendy, on the special schools of Manchester, and relating only to families in which one child was sufficiently defective to be educated in such a school. Very little trace of any unfavourable influence of the parental alcoholism is found. The mean heights and weights of the children of sober parents are, on an average, slightly greater than those of the children of alcoholic parents, age for age, but the difference is extremely small, and the general health of the children of intemperate parents appears to be rather the better of the two; cases of tuberculosis and of epilepsy are stated to be markedly less frequent than amongst the children of sober parents. No marked relation of either sign is found between parental alcoholism and the intelligence of the child. The data of the Edinburgh report as regards the extent of parental alcoholism are rather remarkable. A school of a "widely representative character" was chosen for investigation, and the fathers of more than half the children in this school, and the mothers of more than one-third, are classed under the headings "drinks" or "bouts," *i.e.* are judged to be drinking more than is good for them or their homes.

ACCORDING to the report for 1909, the Field Museum at Chicago extended its operations, and at the same time largely increased its collections, by the dispatch of expeditions to Tibet, the South Sea Islands, and the Philippines, and smaller parties to Guatemala, New Guinea, Fiji, &c., while important collections have been acquired by purchase from Egypt and New Guinea. To make room for these, obsolete and unsatisfactory specimens have been removed from the exhibition galleries, while economy of space has been gained by re-arrangement of the store-collections. Among striking additions to the public galleries, special reference may be made to the Tonopah meteorite from Nevada, weighing nearly two tons, to a pair of African elephants mounted in striking attitudes, and likewise to a fine male gorilla.

AFTER mentioning his regular attendance, when Prince of Wales, at the meetings of the trustees at the Natural History branch of the British Museum, the *Field* of May 14 states that in the early 'nineties, when Sir William Flower commenced to replace the old specimens in the mammal galleries by well-selected examples of modern taxidermy, the late King gave instructions that a series of rats, rabbits, and hares should be trapped on the Sandringham estate and forwarded to the museum, and it is these by which the species are still represented in the British saloon. To the late King the museum is also indebted for the skull and the mounted heads of three Spanish draught oxen, an Indian wild boar, and, in some degree, the makhna (tuskless) male Indian elephant, Jung Pershad. King Edward's last gift to the museum was the skeleton of Persimmon. The only specimen in the bird gallery presented by his late Majesty, when Prince of Wales, is a fine Reeves's pheasant, shot in the Sandringham coverts in 1890. It was, however, at the late King's suggestion that Mr. Andrew Carnegie presented the model of the skeleton of Diplodocus to the museum.

IN the May number of the *American Naturalist* Dr. W. J. Holland, director of the Carnegie Museum, Pittsburg, discusses the views recently expressed—particularly those of Dr. Tornier—with regard to the proper position and pose of the limbs of Diplodocus and other sauropod dinosaurs. Early in his criticism the author takes occasion to emphasise the marked distinctness of the Dinosauria from all other reptiles, a circumstance which is of itself in some degree sufficient to render it probable that their limbs may have approximated to the mammalian type in regard to the relative position of their bones. Important evidence in support of this is afforded by the compressed, instead of depressed, form of the thoracic cavity, which appears absolutely incompatible with limbs arranged after the crocodilian fashion. It is also shown that if the femur is placed, as Dr. Tornier suggests, in a horizontal plane, its head cannot be made to enter the acetabular cavity of the ilium, while, on account of projections, no movement would be possible. Further, in this mode of restoration the distal articular surfaces of both humerus and femur would project at right angles to the axes of the bones of the lower segment of the limbs without being opposed to the corresponding articular surfaces of the latter. After a reference to the extraordinary position which would be assumed in certain circumstances by the fore-limbs of Diplodocus according to the new restoration, Dr. Holland maintains that the form given to the limbs in the skeleton in the Natural History Museum is in all essential features correct.

EGGS with two yolks occur not uncommonly, but eggs with three yolks are exceptionally rare. Such an egg was recently laid by a barred Plymouth rock pullet at the Maine Experiment Station, and is described in some detail in a Bulletin recently issued. The egg was somewhat above the average size, but no other abnormal feature was noticed.

IN past years, when sugar cultivation was the only industry of importance in Barbados, it was customary to issue annually a bulletin on sugar-cane experiments, but now that the cotton industry is developing so rapidly, it

has become necessary to issue a report on similar lines to those already sent out from other West Indian colonies. The first of these, which has been sent to us, contains an account of the sugar experiments, which are still being continued, of experiments to find more suitable types of cotton than those at present in cultivation, and on important food crops such as sweet potatoes, cassava, eddos, and tannias.

THE March number of the *Journal of the Board of Agriculture* contains an article by Mr. A. D. Hall summarising the results of trials at Rothamsted on the new nitrogenous fertilisers, cyanamide and calcium nitrate ("nitrate of lime"). Both proved equally as effective as sulphate of ammonia and nitrate of soda in increasing the yield of grain, but the nitrates were perhaps the better for straw production. Sulphate of ammonia and cyanamide gave somewhat less offal corn than the nitrates—10 per cent. of the total, against 13 per cent.—but the differences throughout are so small that they may be disregarded. The choice between the manures will therefore be dictated by their relative price and by the character of the soil.

THE results of the experiments carried out by the scientific staff of the Royal Agricultural College, Cirencester, have hitherto appeared in the *Agricultural Students' Gazette*, but it has now been decided to publish them in a separate journal, the first issue of which has reached us. Summaries are given by Prof. Kinch of the experiments on grass land carried on continuously since 1888, the general result being that nitrogenous and phosphatic manures are particularly necessary, and the addition of potassium salts desirable, over a long series like the present. The cereal experiments (barley from 1885–91, oats from 1894–5) are also described, together with others that have gone on for a shorter period. A meteorological summary would add to the interest of these papers. Whilst there are many advantages in separate college bulletins for the publication of demonstration results, we hope that all papers of general interest bringing out new facts will appear in the recognised journals, where there is no risk of them being overlooked.

IN the Bulletin of the Cracow Academy, 1909 (June and November), Dr. Maryan Smoluchowski discusses the instability or "buckling" of elastic plates and its applications to problems of mountain formation.

IN the Journal of the Royal Statistical Society, lxxiii., 1 (1910), Mr. G. Udny Yule gives a solution, based on probability considerations, of the problem of the distribution of deaths with age, based on the supposition of a succession of causes of death which act cumulatively, and he considers applications to deaths in man caused by disease and to the extinction of bacteria by successive applications of disinfectants.

IN the *Popular Science Monthly* for March and May Prof. John B. Smith gives an address on "Insects and Entomologists: their Relations to the Community at Large." While the first article deals with insects in their economical aspect, the second consists of a collection of biographical notices, with portraits of the principal entomologists of America.

DR. JEAN MASCART, of the Paris Observatory, has issued a list of errata which he has discovered in Borda's classical tables of logarithms. It is interesting to note that the tables were completed by Borda by the year 1792, but were not all in print at the time of the author's death. The publication was concluded by Delambre, who carefully checked them with the help of Briggs, Vlacq, Véga, Hobert, and Ideler, and the present list evidently represents purely typographical errors which escaped notice, and which would probably in most cases be obvious to anyone who happened to take these particular logarithms from the tables.

THE assessment of income-tax is a question which does not, as a rule, fall within the purview of a scientific journal. We have, however, received a reprint from the *Daily Telegraph* of an article on this subject by Mr. William Schooling (London: Constable and Co., 1910), in which the author proposes a substitute for the present illogical and unscientific system of graduation. According to his system, the tax which a man pays would increase continuously with his income, as shown by a continuous graph. Under the existing system the tax increases discontinuously at certain points where the rate becomes infinity in the pound, and the amount of the tax depends, not only on a man's income, but on whether this income falls on a lucky number such as 4999 or on an unlucky number such as 5001, the man in the latter case paying more and receiving less than in the former. Mr. Schooling's system is much more rational and scientific, and has all the advantages which he claims for it.

THE illustrated catalogue of microscopes and accessories recently issued by Messrs. Flatters and Garnett, 32 Dover Street, Manchester, provides a very full list of apparatus by leading English and foreign makers for which they act as agents, and numerous sundries, some of which are the special designs of the firm. Among these are the hand microtomes provided with discs for regulating the thickness of sections and arrangements for keeping the paraffin blocks steady. The firm also specialises in turn-tables, water-baths and ovens, and slide cabinets.

WE have received separate copies of several contributions from the Jefferson Physical Laboratory of Harvard University which appeared in the March number of the Proceedings of the American Academy of Arts and Sciences. Amongst them is one on certain thermal properties of steam by Mr. H. N. Davis, in which the author, after a critical examination of the experimental work on the subject done during the last twenty years, comes to the conclusion that the total heat of saturated steam up to 190° C. is best represented by the expression

$$H = H_{100^\circ} + 0{\cdot}3745\,(t-100) - 0{\cdot}00099\,(t-100)^2,$$

where H_{100° has the most probable value 639·11. Outside this range of temperature the latent heat L is best given by an equation of the form suggested by Thiesen, *i.e.* $L = 92{\cdot}93(365-t)^{0{\cdot}315}$, in which 365° is the critical temperature of steam. The question of the true value of the specific heat of steam at constant pressure cannot be settled on the contradictory experimental data at present available.

MESSRS. A. GALLENKAMP AND CO. (19 and 21 Sun Street, E.C.) have just issued a circular containing a description of a technical series of physical apparatus. The majority of the items described are connected with the subject of heat, and relate to the determination of coefficients of expansions of solids, liquids, and gases, vapour pressures, and specific heats. A simple apparatus for the rapid determination of specific heats consists of a Dewar flask which contains a hot liquid; into this the cold body under test is dropped, and the fall of temperature is noted; the procedure is therefore the converse of that usually adopted in the method of mixtures. The use of the Dewar flask enables this to be done without sensible error. A lecture apparatus to illustrate Carre's ice machine is designed to

overcome the difficulty experienced by lecturers in causing water to freeze by its own evaporation. A glass tube 50 cm. long and 5 cm. diameter is closed at both ends and filled with coarse glass wool to give more surface. A lateral tube near one end connects with a round-bottomed flask (or, better still, with a Dewar flask); another lateral tube near the other end connects with an exhaust pump. The flask is first half-filled with water, and the glass wool is saturated with fresh strong sulphuric acid. The formation of ice is very rapid. Grace's apparatus for determining the mechanical equivalent of heat also deserves mention as being a cheap pattern of the modern rotating cylinder form of apparatus for this purpose.

THE May number of *Knowledge* appears under new auspices. The editors are now Mr. Wilfred Mark Webb and Mr. E. S. Grew; and Hardwicke's *Science Gossip* is incorporated with the journal, as well as *Illustrated Scientific News*. In an introductory note Principal Miers gives encouragement to scientific amateurs to pursue their observational work in spite of the gulf that may exist between them and the trained specialist. In astronomy and natural history particularly, the work of amateurs is often of great value to science, and any efforts made to stimulate it must be appreciated by professional men of science. The new number of our contemporary should be of assistance in this direction. There are several fine illustrations in the form of plates and other figures, and the articles are by contributors who write with authority and not as the scribes. Among the astronomical articles we notice one on Halley by Mr. T. A. Bellamy, a characteristic contribution by Mr. J. E. Gore on counting the stars, and a description of Prof. Lowell's observations of Martian canals. Dr. D. H. Scott, F.R.S., writes upon the earliest flowering plants—a subject which he has made his own—Prof. F. Cavers upon liverworts, and Prof. A. W. Porter upon electromagnetic mass. There are also the usual notes upon recent advances in the various departments of science, and reviews of books. We offer our congratulations to the editors upon the attractive character of their first number, and trust that their efforts to promote and extend intelligent interest in science will meet with success.

BOTANISTS alone, so far as we are aware, have a journal dealing purely with the jests and humours of their subject. The first number of the *Sportophyte*, edited by Dr. Marie Stopes, emanates from Manchester University, and is to appear yearly. It contains anecdotes, verse, and articles parodying serious journals, of which the highly technical and friendly humour will appeal to professional botanists.

THE first part of a catalogue of books on natural history, to be obtained from Mr. Francis Edwards, 75 High Street, Marylebone, W., has been received. It is concerned with miscellaneous and general books and those dealing with ornithology and oology. The second part of the catalogue will deal with works on botany, gardening, ichthyology, and other subjects.

OUR ASTRONOMICAL COLUMN.

TOTAL SOLAR ECLIPSE OF MAY 9.—According to the *Daily Mail* of May 19, Mr. Driffield, a surveyor, reported to Mr. Baracchi, director of the Melbourne Observatory, that he observed the solar eclipse of May 9 at Queenstown, Tasmania, in clear weather. According to him, the corona appeared regular in form, concentric with and evenly distributed around the moon's disc, except in the south-eastern quadrant, where two streamers were seen running straight for some distance, and then curving downward like a plume. The extent of the corona was more than half a degree from the limb. Its structure was striated, the colours merging gradually from deep orange to pale green. The streamers were two moon's diameters in length. Mr. Baracchi is recorded to have said that this is the best observation which was obtained.

SOLAR ACTIVITY.—After a period of quiescence the sun has, during the past week, exhibited a recrudescence of spot activity. Several moderately sized groups have been observed containing well-defined extensive umbræ.

COMET 1910*a*.—According to an ephemeris published by Prof. Kobold in No. 4410 of the *Astronomische Nachrichten*, comet 1910*a* is still almost stationary to the west of the Great Square, and its estimated magnitude is about 12·0. For May 27 its position is given as

$$\alpha\ (1910\cdot0) = 22\text{h. } 31\cdot5\text{m.},\ \delta = +29^\circ\ 29\cdot8'.$$

THE PROBLEM OF THE RESISTING MEDIUM.—In No. 4408 of the *Astronomische Nachrichten* Mr. Selig Brodetsky, of Cambridge University, discusses Prof. See's assumptions concerning the possible part played by a resisting medium in the capture of satellites. In conclusion, he shows that the arguments employed by Prof. See will not stand close analysis, and are such as to render the possibility of capture, with an assumed resisting medium, very uncertain. That such a satellite as the moon was captured in the manner suggested appears to be extremely improbable; while some of the larger planets have apparently been able to capture a number of comets, rendering them periodic, there is no known case in which the earth has been able to perform a similar operation.

THE CALCIUM BANDS AT λ 6382 AND λ 6389.—In the spectra of sun-spots the calcium bands with heads at $\lambda\lambda$ 6382 and 6389 are an important feature, to which attention was directed by Prof. Fowler, but their precise origin is not quite settled. Investigations on this point have been carried out by Prof. Barnes at Bryn Mawr College, who describes his latest results in No. 2, vol. xxxi., of the *Astrophysical Journal*.

In dry air at atmospheric pressure, and with pure metallic poles, these bands do not appear in the arc spectrum, but with the pressure reduced to 3 cm. of mercury, or less, they come out strongly. In atmospheres of dry hydrogen and pure dry nitrogen the bands do appear, but not so strongly as when the arc is run *in vacuo*; with the arc burning in SO_2 they do not appear.

It has been suggested that these bands are due to a compound of calcium and hydrogen, but, from his experiments, Prof. Barnes concludes that they may be considered as true metallic radiations, a conclusion which is important in discussing the probable origin of the sun-spot spectrum.

STARS WITH VARIABLE RADIAL VELOCITIES.—In No. 2, vol. xxxi., of the *Astrophysical Journal*, Mr. O. J. Lee publishes the results of recent observations of radial velocities with the Bruce spectrograph at the Lick Observatory. For α Cygni a range of 9 km., from $-9\cdot0$ to $-0\cdot1$ km., was found, but the observations do not suggest a period. Two members of the Taurus stream of stars discovered by Prof. Boss, Nos. 1007 and 1092 in his catalogue, have also been shown to vary their radial velocities. The first is 58 Tauri, the range of its velocity being from $+41$ to $+15$ km., and the second is B.D. 7° 681 Tauri, which exhibits a range of from $+34$ km. to $+17$ km. θ Pegasi is also shown to be a spectroscopic binary with a range of from -32 to $+19$ km., and on one plate shows a very faint component at $+62$ km.

OCCULTATION OF MARS BY THE MOON ON APRIL 13.—Through a break in the clouds Dr. W. Krebs was able to observe the last contact during the occultation of Mars by the moon on April 13, and, in No. 4407 of the *Astronomische Nachrichten*, he gives the time as 10h. 49m. 30s. $\pm$ 15s. (G.M.T.).

OBSERVATIONS OF HALLEY'S COMET.

Observations at the Madrid Observatory and Malta.

In a communication which has been received from Dr. F. Iñiguez, the director of the Astronomical and Meteorological Observatory of Madrid, a brief account is given of the visual observations of Halley's comet made at that observatory, accompanied, not only with several excellent photographs showing its general appearance, but with a photograph and drawing of the spectrum of the nucleus and tail.

According to Dr. Iñiguez, the nucleus underwent many variations in size, and these changes can be gathered from the following figures which he gives. Thus on April 21 it had a diameter of 10″; on May 5, 7″; on May 7, 8″; and on May 10 it was only 5″ in diameter. During May the nucleus was comparable with a star of the first magnitude, that of May 10 being a little brighter.

From photographs taken with a doublet of 5 inches aperture, the first view of the comet only indicated a tail a few minutes of arc in length. On April 25 it extended to one degree. On April 28 it was increased to four degrees. By May 5 it had reached a length of ten degrees;

FIG. 1.—Photograph of Halley's Comet taken at the Madrid Observatory on May 11.

on May 11 its length was thirty degrees, and on May 14 it is described as extending about sixty degrees. The accompanying illustration (Fig. 1) shows the comet as photographed on May 11, the exposure lasting from 2h. 58m. a.m. to 3h. 44m. a.m. official Madrid time.

On May 7 and 8 the comet was photographed with a prismatic camera, using a Grubb lens of 8 inches aperture and a prism of twenty degrees angle. The photographs obtained displayed a spectrum which was continuous, but crossed by three monochromatic bands. On May 9 and 10 visual observations of the comet's spectrum were also made, and these also indicated a continuous spectrum crossed by three bands. The wave-lengths of the bands in the spectrum of the nucleus are given as 561 λ, 510 λ, and 472 λ, while those in the tail are 550 λ, 505 λ, and 461 λ. The forms and positions of the bands are given in the accompanying drawing (Fig. 2), which is a reproduction of that sent by Dr. Iñiguez.

The second communication is from Mr. C. Leach at Malta, dated May 16, who writes:—

"Enclosed is a sketch of what was seen here between 2.45 and 3.15 a.m. of May 13 and 14. The position and size of comet were easily noted owing to the clear sky. The chief thing noticeable was the great change in position since May 10, on which date I sent you a sketch of same. The position of the head on May 14 was as shown, forming a rough parallelogram with β, α of Andromeda and γ of Pegasus; in fact, the head was below γ to the extent of the distance α, γ. The tail was quite distinct to ζ of Pegasus and γ of Aquarius, and just filled the space between them. A star was seen through the tail at its extremity.

"The width of the comet at the head was about one-seventh of side γ, α of Pegasus, and the tail about one-third of same at broadest part, roughly speaking, 2° and 5° respectively. By referring to a star-map, I made out the head to be near to ε of Pisces, so that the length must have been nearly 45°.

"We must have been in a very favourable position and have had ideal conditions, as I see Greenwich observations on May 10 make out the tail only 45 minutes.

"I am sorry I cannot sketch better, but I have a difficulty in representing just the correct degree of light in the tail, which is much fainter after α of Pegasus.

"The nucleus was equal to α of Andromeda in brightness.

"The reflection of Venus on the sea was splendid.

"I think there can be no mistake about the length of the tail of the comet being great enough to allow the earth to pass through it, in spite of statements to the contrary.

"It was seen by several people here; in fact, the general appearance of the comet is summed up exactly in the comparison used by several, 'Just like a searchlight from the fort.' It was not seen on May 15 and 16 owing to a sirocco haze."

Mr. Leach's drawing is here reproduced (Fig. 3) on a

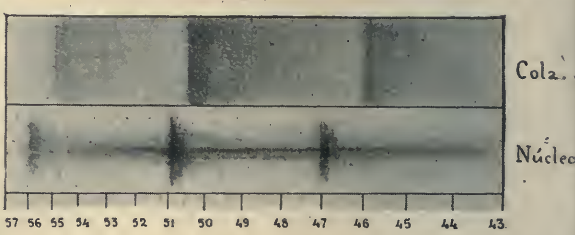


FIG. 2.—Spectrum of Halley's Comet observed at the Madrid Observatory.

reduced scale, and illustrates very clearly the comet's form and position among the stars.

Passage between the Sun and Earth.

The possibility of the mutual interaction of the comet and earth when the former passed directly between the earth and the sun on May 19 aroused great interest. A telegram from the Kiel Centralstelle gave the time of the comet's passage across the solar disc as ingress 3h. 22·7m. a.m. (G.M.T.), egress 4h. 22·5m. a.m., but, with one exception, all the reports yet to hand state that no trace of the comet was seen during the passage. The exception was at the Munich Observatory, where, according to Reuter's Berlin correspondent, the observers "succeeded in catching a glimpse of the comet as it passed across the sun's disc"; until official confirmation is forthcoming, this statement should, we think, be accepted with reserve. At other German observatories no trace of the comet was seen, and at Munich the sun would not rise until the commencement of the passage; its altitude, therefore, would be very small.

The greatest hope for detailed observations of the comet during its passage was centred on the Kodaikanal Observatory, in southern India, where careful preparations had been made for visual, photographic, and spectroheliographic observations. *Inter alia*, it was proposed to take photographs with the spectroheliograph, with the primary slit set on one of the strongest cyanogen bands, in the hope that the cometary radiations might thereby become differentially intensified in the image, just as the hydrogen or calcium radiations ordinarily are. But, according to a telegram sent by Prof. Michie Smith to the *Daily Mail*,

the results were negative; neither the visual nor the photographic observations revealed any certain trace of the comet during its transit of the sun's disc. The day was cloudy, but the definition was splendid, and the comet's tail had been easily seen in the early morning. It therefore seems certain that the tenuity of the matter forming the head of Halley's comet has not been overstated.

In England the sun did not rise until, according to computation, seven-tenths of the passage was effected, and bad weather effectually prevented any possibility of observation. In a telegram to the *Daily Mail* Prof. Dyson reports that the sky was clear, on May 19, from 1 a.m., but no meteors, aurora, or other unusual phenomena were seen at the Edinburgh Observatory. The reports from the African and Australian observatories are similarly negative.

The Rev. Dr. A. Irving writes, however, from Bishop's Stortford on May 18 as follows:—

"We are here at about 250 O.D. and well away from the London atmosphere. The day has been overcast until about 4 p.m., but the later hours have been clear. I have looked for anything abnormal, but have not been able to observe anything beyond a slight and diffused haze, which seemed to be perhaps more continuous than usual into the upper strata of the atmosphere. At sunset the western sky was clear of clouds, but the glow was quite an ordinary occurrence, except that it seemed somewhat fainter than usual with such a sky. But I do not recollect having ever seen a sunset in such a sky with such feeble after-effects. It may be said that there was no *after-glow* at all: merely a dull grey effect, as if the comet's tail had no effect beyond acting as a sort of screen to the sun's rays. It might be interesting to know if similar 'naked-eye' observations were made by others."

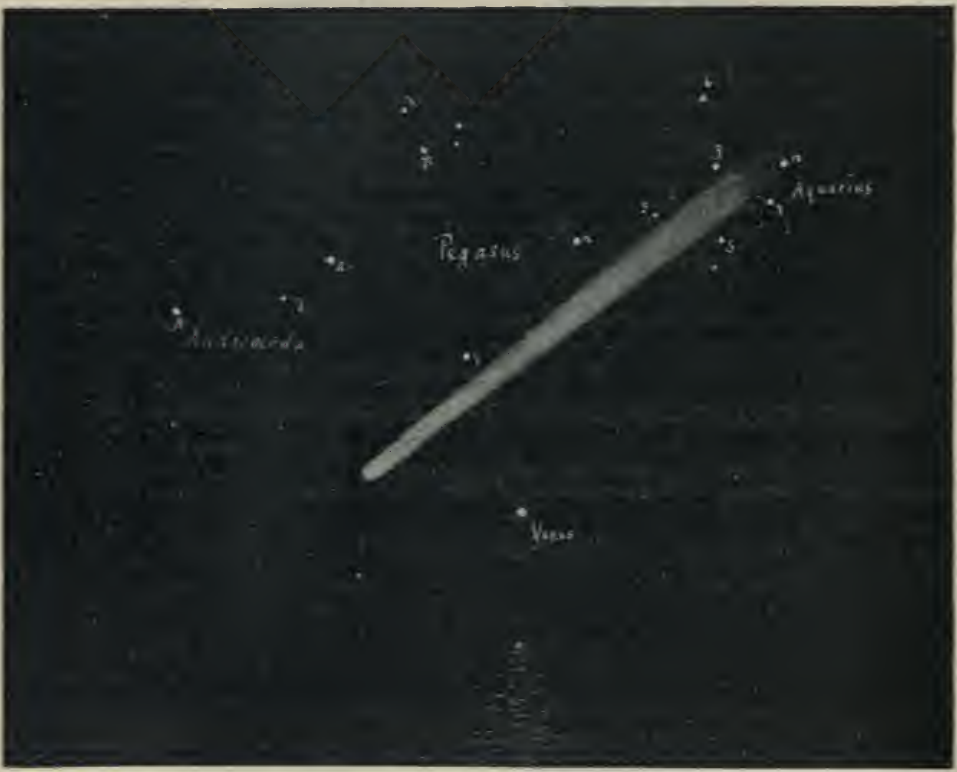


FIG. 3—Halley's Comet as seen at Malta on May 14 by Mr. C. Leach.

The time of the passage of the earth through the extremely tenuous tail was, and apparently still is, uncertain. A week or so before the passage was due there appeared to be some doubt whether the tail was sufficiently long to reach the earth, but this was dispelled by the later observations. Prof. Barnard, on May 18, traced it to a distance of 107° from the head, which implies an actual length of more than fifty million miles, more than three times the necessary extent.

But the actual curvature of the tail could not be determined, and in that lay the uncertainty as to a passage taking place; for the same reason the time of the earth's passage was indeterminable, although Dr. Franz calculated that it should occur some time later on May 19. Observations at Johannesburg indicate that the earth passed under the tail on Saturday morning.

The possibility of this occurrence appears to have incited a great deal of fear and excitement, despite the explicit statements of well-known astronomers that any catastrophe was improbable in the extreme. The fear of poisoning by cyanogen seems to have been the best defined, and to have led to some eccentric precautions, such as an oxygen-supplied sealed room, &c. The accounts of prayer-meetings held by negroes in the southern States, and of general absolution being given by Italian priests, vividly recall the Biela scare of 1882, when Holmes's comet was discovered.

Unfortunately, astronomers and sensationalists alike have been disappointed. According to Johannesburg observations on Thursday, the tail was seen still well above the ecliptic, and observations generally failed to indicate any phenomena which might assuredly be connected with an encounter. Careful preparations were made to observe possible magnetic disturbances, auroræ, and meteors, all or any of which might be produced by the earth's passage through a charged, meteoric agglomeration. The magnets at Greenwich indicated no abnormal disturbance on May 19, but, according to Reuter, Prof. Birkeland's instruments at Finmarken registered a well-marked magnetic storm on that day, although the days before and after were exceedingly quiet. Prof. Birkeland ascribes this to electrical effects produced by the passage of the earth through the charged cometary matter, and has secured excellent magnetograms and earth-current curves, as well as valuable electrical and meteorological observations.

The reports received at the Meteorological Office contain no references to unusual meteorological phenomena which may be associated with Halley's comet. Thunderstorms occurred on each day of the week in some part of the United Kingdom. A sharp storm in the south-east of England in the early morning of Thursday, May 19, just about the time of the calculated transit of the earth through the comet's tail, attracted much attention. It would, however, be rash to attribute their electrical manifestations to cometary influence, for the general meteorological situation, which was characterised by high pressure over Scandinavia and low pressure over the Bay of Biscay, was of a type which in summer is generally associated with thunderstorms over the British Isles. The results of the kite and balloon ascents carried out on May 19 have not yet come to hand.

The Comet and its Spectrum.

M. Coggia, in No. 19 of the *Comptes rendus* (May 9, p. 1165), gives positions for, and descriptions of, the comet for a number of dates between April 16 and May 6. On April 16, 17, and 18 the comet was seen to have a large nucleus, ovoid in shape, but no tail. Seen with the naked eye on April 21, it was of about the third magnitude and yellowish in colour; telescopically, the enveloping coma showed two jets in position-angle 120°. With the moon nearly full, a 3° tail was seen on April 23, and was bifurcated. On April 26, with the moon at full, a 1° tail was seen, and a telescopic view showed that the nucleus was smaller than formerly, but was extraordinarily brilliant and decidedly stellar. May 5 found the comet as a second-magnitude object with a tail 10° in length having a curved, plume-like form at its extremity. Seen in the telescope, the nucleus was round and very bright, and was surrounded by a coma containing two aigrettes. These were broad and were symmetrical with regard to the nucleus, from which they emerged in directions perpendicular to the axis of the tail. On May 6 the nucleus was yet brighter, and the aigrettes had disappeared, but there was a very bright sector turned towards the sun.

A circular from Kiel announces that observations at the Lick Observatory, on May 20, showed the length of the tail to be 140°, that is to say that, were it all visible, it would traverse more than three-quarters of the visible hemisphere. The observations were made in the morning in the eastern sky, and showed the tail to lag far behind the radius vector, so it was suggested that the earth would not pass through it. On the morning of May 21 the tail was fainter, but was traced to beyond Aquila.

A correspondent, Mr. E. Clegg, at Morenas, near Pernambuco, reports that during the early days of this month the comet was seen very plainly at about 4 o'clock each morning by a number of people.

Despite the smoke and cloud near the horizon, and the full moon, the comet was seen as a conspicuous object by thousands of people in various parts of the country on Sunday evening last. At Gunnersbury it was first picked up at 8.45, although the sky was by no means dark, but, probably owing to the bright moonlight, the tail was only suspected. Mr. W. E. Rolston reports that, to the naked eye, it appeared as a white, nebulous cloud, of appreciable size, having a bright centre. By averted vision 2° or 3° of the tail was glimpsed at intervals.

The results of a number of spectrum observations, made at the Meudon Observatory during the period January-May, are published, by MM. Bernard and Idrac, in No. 19 of the *Comptes rendus*. In January the cyanogen band at λ 388 dominated the spectrum of the head. The photographs obtained on February 9 and March 2, 3, and 4 show, in addition, the blue "carbon" band at λ 474 and others, more feebly, near λ 408 and λ 438; in the later spectra the bands at λ 388 and λ 474 were nearly equal in intensity. A visual observation by M. Giacobini on April 17 showed the nucleus to be stellar in character with a circular nebulosity surrounding it, but to the Meudon observers on April 25 the condensation was planetary in character, with uniform luminosity over a circle some 5″ in diameter. A nebulosity of 30″ diameter surrounded it, and showed two short jets on the opposite side to the sun. Photographs taken on April 26 showed that the tail was developing in the form of two jets about 1° in length separated by an angle of some 8° or 12°.

Spectrograms obtained on April 26 showed only the band at λ 474, but others, secured on May 4, showed the continuous spectrum of the nucleus, and, in the head, the bands at λ 474 and λ 388. It is interesting to note that, probably owing to the differential absorption of the earth's atmosphere at a low altitude, the band at λ 388 was much fainter than that at λ 474.

On May 7 the comet was much brighter, its estimated magnitude being 0·5, and a tail 1° long was easily seen with the naked eye. The head of the comet exhibited several modifications, the nucleus now being elongated in the direction perpendicular to the sun-comet line, and having a luminous jet at each extremity of its major axis. Spectra, taken on Σ and Wratten and Wainwright's orthochromatic plates, show the intense continuous spectrum of the nucleus extending from λ 660 to λ 395. The band at λ 474 is very intense in the spectrum of the head, which also shows condensations at $\lambda\lambda$ 516 and 563; the cyanogen band at λ 388 is much weaker than on the earlier plates.

Messrs. V. M. Slipher and Lampland also give a good preliminary account of the comet and its spectrum in Bulletin 47 of the Lowell Observatory.

Photographs were secured on every morning between April 14 and May 1 inclusive, except April 28, and indicated some remarkable changes in the form of the comet. On April 30 it was seen that the bilateral symmetry of the earlier photographs of the tail had disappeared; the northern edge was now nebulous, whilst the southern was bright, well defined, and showed several sharp bends. On May 1 the tail was gently curved, first to the north, then to the south, for seven degrees from the head, and then became nebulous, with a number of brighter condensations. This outer part indicates the action of some shattering, perturbative agency, and the proximity of Venus is tentatively suggested as a possible cause. The lengths of the tail, shown on the photographs, range from 1° on April 15 to 18½° on May 1.

The photographic spectra cover the whole range from the red to the ultra-violet, and show many interesting features. One of the most striking is the intensity of the continuous spectrum of the nucleus, the solar origin of which is indicated by the presence of many Fraunhofer lines. More than a dozen emission bands were photographed, the typical cometary bands 3883, 4737, 5165, and 5635 being generally the most prominent. The cyanogen band at λ 3883 is the strongest, and shows progressive intensification. Other notable bands are at λ 4000, prominent in tail; 4214, strong and increasing; 426, prominent in tail; 455, apparently composite, and prominent in tail; 570, faint and narrow; 5893, sodium (emission) lines, varying in intensity; 630±; the continuous band is photographed to a short distance beyond B. The study of the sodium lines from day to day indicated that they fluctuated in intensity.

The objective-prism photographs show that the head and tail are not alike in composition, a point brought out in the study of Morehouse's comet. Two bands, in fact, at $\lambda\lambda$ 4000 and 4260, were first recognised in the tail; 4550 is also prominent in the tail, but inconspicuous in the head. The cyanogen bands at $\lambda\lambda$ 4214 and 3883 are practically absent from the tail.

Other observations of the comet are recorded by M. Esclangon and M. Borrelly in No. 20 of the *Comptes rendus* (May 17).

While visual observations show the tail as straight and bifurcated, photographs show it to be more of the intricate form exhibited on photographs of Morehouse's comet. According to the *Times*, a splendid photograph was secured by Mr. Evershed, with the 9-inch reflector at the Kodaikanal Observatory, on April 22. This shows the nucleus as surrounded by a parabolic envelope, from which radiate a number of streamers in the form of a fan. Instead of the simple bifurcated extension seen visually, this photograph represents the tail as a number of disturbed, bent streamers, one of the brightest of which actually crosses the others. The photograph certainly suggests energetic disruptive action rather than a steady streaming forth, and demonstrates the danger of comparing modern photographic representations of comets with the earlier drawings.

An excellent series of photographs has also been secured at the Helwan Observatory, and copies forwarded to the Royal Astronomical Society.

The complicated structure of the tail is also shown on photographs taken at the Transvaal Observatory on April 16. Describing them in No. 4411 of the *Astronomische Nachrichten*, Mr. Innes says that they show a tail 3° long, divided into five rays, one set of which cross over the others. In the telescope, on the same date, the nucleus was seen to be double, the secondary nucleus being in position-angle 48° 11′. No. 4413 of the *Astronomische Nachrichten* also contains numerous reports of observations of the comet.

The following is part of an ephemeris published by Dr. Ebell in No. 4411 of the *Astronomische Nachrichten*:—

Ephemeris for 12h. Berlin M.T.

1910		R.A. h. m.		Decl. ° ′
May 30	...	9 45·0	...	+2 53·0
,, 31	...	9 50·9	...	+2 23·5
June 1	...	9 56·0	...	+1 57·2
,, 2	...	10 0·4	...	+1 34·2
,, 3	...	10 4·3	...	+1 13·4

The estimated brightness for May 30 is about 0·5 mag., and for June 2, 1·0 mag.

HALLEY AND HIS COMET.[1]

WHAT do we know of the nature of a comet's tail? Near the head we notice that there is a dome-shaped envelope which suggests that something has been spouted from the head and turned back by some repelling force of the sun, much as water spouted from a jet into the air is turned back by the attraction of the earth. The shape of a fountain is, in fact, closely like that of a comet near the head. The same curve, a parabola, characterises both, and accordingly the adopted view of the nature of the tail is on these lines. But Mr. Eddington has recently directed attention to a grave difficulty; he has calculated from comet Morehouse, which appeared eighteen months ago, what must be the magnitude of the sun's repelling force to accord with this view, and he finds it almost inconceivably great. The suggestion was made, accordingly, that possibly a different view might fit the facts better, viz. that the matter was not spouted from the comet's head and turned back by the sun, but came from the sun and was turned back by the comet. Mr. Eddington has done something already to examine this view, and finds several striking facts in its favour. In the first place, the shape of the curve, the parabola, which has been taken as good evidence for the former view, equally fits the latter. Secondly, since the matter is streaming out from the sun, and the comet is moving across it, we must take into account the motion of the matter relative to the moving comet. It should be possible to test the correctness of the view by observing the direction of the comet's tail, which should not lie accurately in the line away from the sun, but should be slightly inclined to it. Measurements of several photographs seem to support this view.

Besides the particles of solid matter which exist in the tail (whether spouted from the comet or from the sun), there are also certain gases. Sir William Huggins found with his spectroscope, as early as 1881, that there were certain carbon compounds in the head of a comet which are doubtless also present to some extent in the tail. Some very interesting spectroscopic observations made on the daylight comet showed that there was sodium vapour, not only in the nucleus, but extending out into the tail on either side. The strong yellow lines in the spectrum have been thought to have possibly some other origin, perhaps helium or a carbon compound. It may appear curious that there should be any doubt, but it must be remembered that when an object is in motion the lines in its spectrum never correspond *exactly* with the lines of a terrestrial substance. They are displaced to one side or another according as the object is moving towards or from us. However, in the present instance measures made at the Lick Observatory seem to identify the lines as sodium lines when due allowance is made for the comet's motion away from the earth. Prof. Fowler has recently made an interesting identification of the spectrum of a comet's tail with that of some substance which at present he has not completely recognised, but which he believes to be a compound of carbon, hydrogen, and oxygen in a state of great tenuity. He can obtain a spectrum in his laboratory when the pressure is reduced to less than 100,000th of atmospheric pressure.

The particular interest of Halley's comet lies, not in the fact that we shall pass through its tail, not in the magnificence of the spectacle which we hope to see (for this will be much less sensational than, for instance, the comet of 1858, or even of 1882), but in the circumstances which first brought its existence to the knowledge of the world. It was the first comet of which the return was predicted with success. Halley reaped this reward, the great reward of having an enduring monument in the skies, as the well-deserved outcome of his devotion to science. He was one of those men who seem to have an instinct for discerning at any particular moment the most important thing to be done, and the energy to do it, such a man as would have made a great general or a great statesman, or succeeded in many other walks of life, and such a man as is only too rare in the history of science. When an undergraduate at Oxford (Queen's College) he was struck by the fact that our knowledge of the stars was practically limited to those of the northern hemisphere, and he determined personally to rectify this at the earliest possible moment. Accordingly, he did not wait even to take his degree, but started for St. Helena to make a catalogue of southern stars. Bad weather rendered his expedition far less successful than he hoped, but, nevertheless, a beginning was made, and the foundations of our knowledge of the southern hemisphere were laid. He gracefully acknowledged the help and patronage of the King by naming a small constellation "Robur Caroli II.," but the name was afterwards omitted by a German editor. His name for a striking double star, Cor Caroli, has survived. In later years his studies of the positions of the stars convinced him that they were not really fixed in their places, but that some of them must have moved since the observations of Ptolemy. From this beginning, due to Halley, springs our knowledge of the proper motions of the stars and all that has come from it.

Another of Halley's great enterprises was the attempt to determine longitude at sea. It is quite easy for a sailor to determine his latitude (how far, that is, he is north or south of the equator), but his longitude is a different matter, and the uncertainty often led to grave difficulties and often disasters. Here, again, Halley saw that a great effort must be made to remove this disability. He obtained the loan of a ship from the King (not Charles II. by this time, but William of Orange), and was instructed to make a long voyage, especially in the southern hemisphere, to observe the magnetic variation, that is to say, the amount by which the compass points east or west of due north in various localities. In spite of the mutiny of his lieutenant (which caused his return home after first setting out), he completed his voyage. He made a chart of the variations, and thus solved, for the first time, this problem of determining the longitude. His solution was very soon superseded by a better, in the invention of the chronometer by John Harrison; but this does not alter the fact that Halley was the first to give a solution at all. Even his own defects seem to have inspired him to a method of compensating them. He was himself not a very accurate observer, nor skilled in the use of the instruments of a fixed observatory. Possibly his experience with rough and ready methods at sea may have contributed to this end. Be that as it may, he was so far out of personal sympathy with accuracy in observation that he used to say, "Take care of the minutes of arc and the seconds will take care of themselves." It is, therefore, not to be wondered at that his observations as Astronomer Royal were not of any value; and it might have happened that he would look for a successor equally indifferent to accuracy, but he was too great a man to make such a mistake. He set his heart upon being succeeded by Bradley, the most painstaking and accurate observer of the time (possibly of all past time), and Bradley's skill soon made up for any deficiencies of the previous twenty years.

But Halley showed his greatest insight in connection with the discovery of the great law of gravitation. He shared with others the suspicion (for in 1684 it amounted to little more) that a law of attraction, varying as the inverse square of the distance, would explain the movements of the planets round the sun; but while others were content to let the matter rest there, or to claim, falsely, that they had satisfactorily proved the proposition, Halley saw the vital necessity of sifting the matter to the bottom. When other inquiries had failed, he determined to visit Newton, at Cambridge, with the idea of enlisting his help in solving this great problem. To his great delight he found that it was already solved. Newton had already

[1] From the Aldred Lecture delivered before the Royal Society of Arts on May 4 by Prof. H. H. Turner, F.R.S.

proved that an object attracted by the sun in this way would move round it in an ellipse, and, since Kepler had already shown that the planets did move in ellipses, the existence of gravitation was established. Halley saw, further, how important it was to publish this discovery, and paid for the publication from his own pocket when other means failed. It might also be said that in this one particular of recognising the thing to be done and doing it Halley compared favourably with his great friend Newton, for Newton, after proving the proposition, had tossed it aside, shrinking from publication, which had sometimes engaged him in disagreeable controversy. Had it not been for Halley we might have lost this discovery, at any rate for a number of years; but Newton, though he was diffident as to publication, and failed perhaps to realise the importance of his discovery to the world, proved his own remarkable insight in a different manner. He, and he alone, saw that, even after the proof about the ellipse had been formulated, there was yet a grave difficulty in accounting completely for a universal gravitation as the cause, not only of the planetary movements, but of the falling of objects towards the earth. He realised that there was need of a further proposition, which he ultimately succeeded in proving, viz. that a sphere, however large, would attract another sphere, however close to it, as though it were concentrated at the centre. This completed the great law which was given to the world in 1686; but without this great proposition the law of gravitation would have remained a mere rough approximation instead of taking its place at once, and thereafter, as the most accurate law known to science.

Not only were the movements of the planets explained, but it became possible to calculate the orbits of comets, and Halley took the earliest opportunity of calculating as many as he could. This opportunity did not, however, come to him for nearly twenty years, since he was full of other projects. It was in the interval that he made his great voyage for determining the longitude; and it was not until 1704, when he had been elected Savilian professor of geometry at Oxford, that he found the leisure to make the cometary calculations required. The result was a list of twenty-four orbits, representing all the comets which had been sufficiently observed. He had the insight to see that this was a thoroughly important thing to do, though neither he nor anyone else suspected what was to be the most important outcome. Three of the twenty-four orbits were found to be nearly the same, those of the comets of 1531, 1607, and 1682. The figures were so closely the same that he felt sure they must relate to the same comet, though there was one difficulty, in that the interval between the two returns was not the same. This discrepancy, however, he rightly ascribed to the influence of the planets, especially Jupiter and Saturn. He pointed out that these planets disturbed one another, and therefore would disturb a comet too. He put very clearly also the point that the disturbance would be much greater in the case of a comet. We have said that a comet travels away to a great distance from the sun, and comes almost to a resting point; indeed, as Halley remarked, a very slight change in its velocity would send it away altogether from the sun's influence, that is to say, would make all the difference between a finite and an infinite time for its return. Hence a smaller disturbance might easily affect the time of its return seriously. There was no difficulty that he could see in identifying the three comets as the same, and in predicting a subsequent return in 1758. Halley did not live to see the return, but died in 1742, at the age of eighty-five, but he left on record his conviction that the comet would appear again, and his hope that posterity would remember to credit an Englishman with the prediction.

It was first seen on Christmas Day, 1758. It returned again in 1835, and now it is with us once more. The interval between the returns varies a few years, from about seventy-five to nearly eighty, the variation being due, as Halley surmised, to the interference of the planets with the comet's movements. It is one thing to realise, as Halley did, the general nature of this interference, and quite another matter, involving much laborious calculation, to determine it accurately. Halley, with his national pride, would have been delighted at the skill with which this problem has recently been attacked by two of his countrymen, Mr. Cowell and Mr. Crommelin, of the Royal Observatory at Greenwich. Mr. Cowell, after trying old methods with more or less success, found it advisable to employ a totally new method. It has been the custom, hitherto, in such calculations to consider the path of the comet as an ellipse, according to Newton's great discovery, but an ellipse which is continually changing in detail owing to the disturbances of the planets. Mr. Cowell, however, has found it desirable to abandon the idea of the ellipse altogether, and to follow the comet, step by step, along its orbit, first forecasting a little ahead, then calculating the consequent attractions of the planets, verifying his forecast or modifying it, if required, and so, by making each step secure before proceeding to the next, obtaining, ultimately, the complete and accurate history of the comet between two returns. It will readily be understood that a process of this kind involves much labour. During seventy-four years the comet was followed by calculation alone, for it was hopeless to attempt to observe it. As a result of the calculations, it was predicted that it would be seen in a certain place in the sky in August and September, 1909, and on taking a photograph of this region the comet was found close to the predicted place. The honour of first identifying it in this way falls to Dr. Max Wolf, of Heidelberg, but it is some compensation to Englishmen that, with the help of Dr. Wolf's information, they were able to identify earlier images of the comet on photographs taken at the Royal Observatory, Greenwich, and earlier still at the new Observatory of Helwan, in Egypt. The generosity of Mr. Reynolds, of Birmingham, has furnished this last observatory with a fine reflecting telescope, the mirror of which, 30 inches in diameter, was, like that at Greenwich, made by the late Dr. Common, of Ealing; and with this fine instrument, in the splendid climate of Egypt, the first picture of Halley's comet at its present return was secured.

Messrs. Cowell and Crommelin have not only calculated the recent history of the comet, they have carried it back through the centuries as far as 240 B.C. We have seen that Halley collected all the observations of comets sufficiently good and numerous to enable him to calculate orbits, and these did not include any comet earlier than 1337, nor any appearance of his own particular comet before 1531. But more observations have come to light since then, especially in Chinese annals, and on further search being made, in the first instance by Mr. Hind some half a century ago, it was found that bright comets had appeared in 1456, in 1378, in 1301, and so on, which could with great probability be identified with Halley's. This probability Messrs. Cowell and Crommelin have now converted into a certainty. It was not possible, or even necessary, to carry back the computations into the past with the same accuracy as was adopted for the last return, for the observations available for identification were, in many instances, very rough, specifying, for instance, the position of the comet by the constellation in which it was seen; but they adopted something of the same principle of proceeding step by step, making the appearance at one return secure before working back from it to the preceding, and thus they were able to correct several mistakes in Hind's original list.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The Council recommends that a grant of 100*l.* from the Worts Fund be made to Mr. E. A. Wilson, of Gonville and Caius College, who has been entrusted with the organisation of the scientific department of the British Antarctic Expedition, 1910, towards defraying the expense of the equipment.

The scientific staff of the expedition includes Messrs. D. G. Lillie, of St. John's College; E. W. Nelson, of Christ's College; T. G. Taylor, of Emmanuel College; E. A. Wilson, of Gonville and Caius College; and C. S. Wright, of Gonville and Caius College.

Grants of 50*l.* to Mr. C. E. Moss, curator of the University Herbarium, towards defraying the expense of botanical investigations which he proposes to make on the Continent of Europe; and of 25*l.* to Mr. R. H. Rastall, towards defraying the expense of a visit which he proposes

to make to South Africa for the purpose of carrying on geological investigations, are also recommended.

OXFORD.—The following is the text of the speech delivered by Prof. Love in presenting Messrs. P. H. Cowell and A. C. de la C. Crommelin for the degree of D.Sc. *honoris causa* on May 21 :—

"Ducentos fere abhinc annos Edmundus Halley, qui tum apud nos Professor erat Savilianus, a Newtono doctus vi quadam certa planetas suos intra circulos contineri, cum cometam magnum ipse observasset, hunc annorum quinque fere et septuaginta intervallis quasi legitimo tempore semper rediturum esse praedixit. Vates erat verus, et nos hoc anno tertium ex illo tempore cometae reditum videmus. Cum quidem omnes astronomi ineunte statim anno eius adventum specularentur, simul atque visus est id egerunt ut cursum quo circa solem volveretur certissime constituerent. Ad hanc rem acesserunt duo viri, Philippus Herbertus Cowell, Andreas Claudius de la Cherois Crommelin, scientia et peritia singulari praediti, qui hunc nodum nova prorsus ratione solverunt. Qua in re distinguere vix possumus quid huic vel illi acceptum referendum sit: illud constat, nisi alter mathematicorum, alter astronomorum peritissimus fuisset, rem non potuisse navari.

"Duco igitur ad vos Philippum Herbertum Cowell, qui, cum plures annos astronomiae rationibus cognoscendis se dedidisset, multas palmas iam adeptus, id tandem consecutus est ut cometae Halleiani iter nova ratione statueret, et omnes calculos laboriose subduceret.

"Duco etiam Andream Claudium de la Cherois Crommelin, qui cum multos annos cometarum naturam investigasset, doctrina maxima instructus ad hoc munus accessit, et re latissime perspecta cometae redeuntis, iter non solum hoc anno definire potuit, sed quoties per duo millia ducentos quinquaginta annos his caelestis hospes terram revisit."

The Vice-Chancellor (Dr. T. H. Warren), in admitting Messrs. Cowell and Crommelin to the degree, spoke as follows :—

"Salve fratrum par nobile, nec laboribus nec laude divisum, quos dum veluti Geminos illos, vel stellam quamdam duplicem, pari gloria, togis paribus fulgentes intueor, venit mihi in mentem aliquid versu dicere Vergiliano, licet paullum mutato,

'In medio duo signa, Conon et quis fuit alter,
Praedixit flammae reducis qui gentibus orbem?'[1]

"Ego auctoritate mea et totius Universitatis libenter admitto utrumque, te Cononem, te Aratum novum, ad gradum Doctoris in Scientia, honoris causa."

THE honorary degree of Doctor of Laws was conferred upon Commander Peary by the University of Edinburgh on May 24, in recognition of his north polar work.

A REUTER message from Salem, Mass., U.S.A., states that the will of the late Mr. Isaac C. Wyman bequeaths practically his entire estate, valued at 2,000,000*l.*, to Princeton University Graduate School for such use "as the trustees may decide."

A REUTER message from Cape Town states that the late Sir Donald Currie's daughters, Mrs. Mirrielees, Mrs. Molteno, and Mrs. Wisely, have given a sum of 25,000*l.* to the University of Cape Town for the construction of a hall as a permanent memorial to Sir Donald Currie. The University has gratefully accepted the gift, and has reserved a portion of the fund, producing 150*l.* per annum, for the foundation of a Currie Scholarship.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, May 17.—M. Armand Gautier in the chair.—The president announced the death of Stanislas Canizzaro, correspondant of the academy, and gave a short account of his work.—Gaston **Darboux**: The use of new methods of recurrence in the theory of orthogonal systems.—M. **Bigourdan** presented photographs of the Halley comet by M. Iñignez, taken at the Observatory of Madrid.—A. **Lacroix**: The mineralogical constitution of the French phosphorites. The optical and physical properties are described in detail, and complete chemical analyses are given.—Paul **Sabatier** and A. **Mailhe**: A general method of direct preparation of the thiols by catalysis, starting with the alcohols. The general method proposed consists in passing a mixture of the vapour of the alcohol with sulphuretted hydrogen over thoria at a temperature between 300° C. and 360° C. The mercaptans from the first five primary alcohols were prepared with excellent yields. The substitution of sulphur for oxygen was also successful with allyl alcohol, benzyl alcohol, and various secondary alcohols, but the yields in these cases were not so good as with the primary alcohols. Thiophenols can also be prepared in the same way.—M. Blaserna was elected a correspondant for the section of physics in the place of Lord Rayleigh, elected a foreign associate.—E. **Esclangon**: Observations of Halley's comet. These results were obtained at the Observatory of Bordeaux, and diagrams are given showing the appearance of the comet on various dates.—J. Comas **Sola**: The flattening of Io, first satellite of Jupiter. Observations with the 38-cm. equatorial at the Fabra Observatory, continued since 1905, have confirmed the view that Io is flattened, in proportion, greater than any other body known in the solar system. The maximum flattening has been determined at one-fourth.—M. **Borrelly**: Observations of Halley's comet made at the Observatory of Marseilles with the comet finder. Data are given for observations for fifteen nights between April 21 and May 10, together with the positions of the comparison stars.—M. **Tzitzéica**: A new class of surfaces.—E. **Ouivet**: The differential equation of the motion of a heavy spherical projectile in air.—Maurice **Fréchet**: Continued functionals.—M. **Herrgott**: The electric thermophile. An account of a woven material containing fine nickel wire, which is supple and can be heated electrically.—A. **de Gramont** and M. **Drecq**: Certain conditions of appearance of the band spectrum attributed to cyanogen. The band spectrum usually considered to be characteristic of cyanogen appears to be due to the simultaneous presence of carbon (in sodium carbonate) and nitrogen. The bearing of this on comet spectra is mentioned.—M. **Houllevigue**: The dimensions of the material elements projected by the kathodes in vacuum tubes. The metal projected (silver) is deposited on a glass plate, and the minimum thickness determined at which the layer conducts electricity. The conductivity appears suddenly, and is only established starting from a certain thickness of the metallic layer. The diameter of the particles calculated from the results of these experiments is of the order of 22 to 26 $\mu\mu$.—A. **Besson** and L. **Fournier**: The action of the silent discharge upon acetaldehyde in the presence of hydrogen. The product of the reaction was a very complicated mixture containing acetic acid and its homologues and several ketones.—F. **Bodroux** and F. **Taboury**: Synthesis of aromatic nitriles. Benzyl cyanide is treated with sodium amide and alkyl iodide or bromide. One or both of the hydrogen atoms of the methylene group can thus be replaced by alkyl groups, and several applications of this general reaction are cited.—Georges **Darzens**: The action of the hydracids upon the glycidic esters.—A. **Arnaud** and S. **Posternak**: Two new isomers of stearolic acid.—Marcel **Godchot** and Jules **Frezouls**: Hexahydrophenylglycollic acid.—C. **Beys**: The estimation of tartaric acid in crude natural materials.—J. **Bertheaume**: A new method of estimating the three methylamines in admixture with ammonia. The hydrochlorides are dried and extracted with pure chloroform, in which the hydrochlorides of dimethylamine and trimethylamine are soluble. These are further separated by means of their periodides, and the ammonia and methylamine separated by François's method with yellow oxide of mercury.—G. **Boyer**: Studies on the biology of the truffle (*Tuber melanosporum*).—Paul **Dop**: The Strychnos of eastern Asia.—J. **Strohl**: The relative weight of the heart and the effect of high altitudes.—Maurice **Nicloux**: The decomposition of chloroform in the organism. A method is described permitting the estimation of small quantities of chloroform mixed with large quantities of air. The author applies this to determine the amount of chloroform destroyed in the blood, and concludes that about one-half the total amount of chloroform fixed at the moment of anæsthesia is decomposed in the organism.—

[1] Cf. Verg. Ecl. iii., v. 40.

H. **Coutière**: Cray-fish of the genus Saron with male dimorphs.—L. **Nègre** and J. **Bridré**: The nature of the parasite of epizootic lymphangitis.—G. **Seliber**: The determination of the volatile acids in the products of fermentation of some micro-organisms according to the method of Duclaux.—L. **De Launay**: The mean atomic weight of the silicated earth's crust.—Jean **Boussac**: The distribution of the levels and *facies* in the so-called autochtone (Nummulitic) of eastern Switzerland.—Maurice **Filliozat**: The chalk of Blois.—Louis **Gentil**: The ancient orogenic movements in the Haut-Atlas of Morocco.

DIARY OF SOCIETIES.

THURSDAY, MAY 26.

ROYAL SOCIETY, at 4.30.—Croonian Lecture: Alterations of the Development and Forms of Plants as a Result of Environment: Prof. G. Klebs.

ROYAL INSTITUTION, at 3.—The Constitution and Internal Structure of Alloys: Dr. W. Rosenhain.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

ROYAL SOCIETY OF ARTS, at 4.30.—The People of Burma: Sir Richard Carnac Temple, Bart.

FRIDAY, MAY 27.

ROYAL INSTITUTION, at 9.—The Forthcoming Antarctic Expedition: Capt. R. F. Scott, R.N.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

PHYSICAL SOCIETY, at 5.—On an Oscillation Detector actuated solely by Temperature Variation of Resistance: Dr. W. H. Eccles.—Exhibition of a Resonance Transformer: A Eagle.—The Limitations of the Weston Cell as a Standard of Electromotive Force: Dr. S. W. J. Smith.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Adjourned discussion* upon Mr. S. N. Brayshaw's Paper on A Research on the Hardening of Carbon and Low-tungsten Tool-steels: Prof. J. O. Arnold.—Comparison of the Tensile, Impact-tensile, and Repeated-bending Methods of Testing Steel: B. Blount, W. G. Kirkaldy, and Capt. H. Riall Sankey.

MONDAY, MAY 30.

ROYAL INSTITUTION, at 3.—Earth-tides: Prof. A. E. H. Love, F.R.S.

TUESDAY, MAY 31.

ROYAL INSTITUTION, at 3.—Heredity in Tudor and Stuart Portraits: Charles J. Holmes.

FARADAY SOCIETY, at 8.—Some Practical Experience of the Sherardising Process: J. W. Hinchley.—Note on the Composition of Eutectic Mixtures: Dr. C. H. Desch.—Relations between Critical Temperature, Boiling-point, and Expansion Coefficient of Phosphorus Pentachloride: E. B. R. Prideaux.—Thermic Reactions in Vacuo. Parts I., II., and III.: F. E. Weston and H. Russell Ellis.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—An Anthropological Expedition to the Northern British Solomon Islands: Dr. R. Thurnwald.

WEDNESDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—The Constitution and Internal Structure of Alloys: Dr. W. Rosenhain.

ROYAL SOCIETY OF ARTS, at 8.—The Restoration and Discoveries at the Guildhall, London: S. Perks.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Composition of Malt Vinegar: E. Russell and T. R. Hodgson.—Some Analyses of Ghee: E. R. Bolton and C. Revis.—A Short Method for Detecting and Estimating Coconut Oil in Butter and Margarine: H. S. Shrewsbury and A. W. Knapp.—The Analysis of Ferrocyanides: Dr. H. G. Colman.—Some Unusual Pathogenic Bacteria in Water: W. Partridge.—The Estimation of Small Quantities of Essential Oils in Spices: J. A. Brown.—An Investigation of Pozzi-Escot's Method for the Estimation of Nitrates: E. Cahen.

ENTOMOLOGICAL SOCIETY, at 8.—Notes on the Scoliidæ, and New Fossorial Hymenoptera from Australia: R. E. Turner.—On the Position of the Rhopalosomidæ, with Description of a Second Species: C. Morley.—Descriptions of Micro-lepidoptera from the Malayan Region: E. Meyrick, F.R.S.

THURSDAY, JUNE 2.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Influence of Bacterial Endotoxins on Phagocytosis (Preliminary Report): Leonard S. Dudgeon, P. N. Panton, and H. A. F. Wilson.—The Origin of Osmotic Effects. III. The Function of Hormones in Stimulating Enzymic Change in Relation to Narcosis and the Phenomena of Degenerative and Regenerative Change in Living Structures: Prof. H. E. Armstrong, F.R.S., and E. Frankland Armstrong.—On the Direction of Motion of an Electron ejected from an Atom by Ultra-violet Light: Dr. R. D. Kleeman.—On Scandium. Part II.: Sir William Crookes, For.Sec.R.S.—The Flow of Water in Curved Pipes: Prof. J. Eustice.

ROYAL INSTITUTION, at 3.—Malaria: Major Ronald Ross, F.R.S.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—Presidential Address: Dr. J. B. Simpson.—A Storage-battery Extension to a Three-phase Colliery Power-plant: W. Maurice.—On Measurements of the Downward Increase of Temperature in Bore-holes, their Technics and their Practical Importance for Geological Prognosis: Prof. J. Koenigsberger and Dr. Max Mühlberg.

LINNEAN SOCIETY, at 8.—On the Flora of Gazaland: Dr. A. B. Rendle, F.R.S., and others.

RÖNTGEN SOCIETY, at 8.15.—Practical Observations on Every-day X-Ray and Electrical Work: Filtration of Rays, Measurement of Rays, Rapid Stereoscopic Method: Dr. Howard Pirie.—Recent Improvements in Radiographic Technique: Dr. R. Knox.

FRIDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

ROYAL INSTITUTION, at 9.—Renaissance Monuments in the Roman Churches, and their Authors: Sir Rennell Rodd, G.C.V.O., K.C.M.G.

INSTITUTION OF MINING ENGINEERS, at 10 a.m.—Experiments illustrative of the Imflammability of Mixtures of Coal-dust and Air: Prof. P. Phillips Bedson.—Testing for Fire-damp: Prof. J. Cadman.—Some Memoranda concerning Coal-dust: H. W. G. Halbaum.

SATURDAY, JUNE 4.

ROYAL INSTITUTION, at 3.—Electric Heating and Pyrometry: Prof. J. A. Fleming, F.R.S.

CONTENTS.

THURSDAY, JUNE 2, 1910.

THE MAMMALS OF SOMALILAND.

The Mammals of Somaliland. By R. E. Drake-Brockman. Pp. xvii+201. (London: Hurst and Blackett, Ltd., 1910.) Price 12*s*. 6*d*. net.

SOMALILAND, it is hardly necessary to point out, for its mammalian fauna, its flora, and to a certain extent its birds, almost constitutes a separate sub-region of the African domain, together with the adjoining districts of Galaland, Abyssinia, and the northern parts of British East Africa. The fullest description of its interesting mammalian fauna was written some years ago by Captain (now Colonel) H. G. C. Swayne, R.E., the discoverer of Swayne's hartebeest, one of the peculiar Somali forms. Since then, alas! through the unending attacks on the Somali fauna by British sportsmen and sportswomen and some of their foreign friends, not a few of the beasts common in the northern or British part of Somaliland in Colonel Swayne's day (beginning in 1885) have now disappeared from that territory or have become extremely scarce, and are not found in the list supplied by Dr. Drake-Brockman. It is curious, nevertheless (since the title of the book under review is "Somaliland"), that its author makes no allusion to some of the most peculiar and characteristic of "Somali" mammals—at least in theory—such as the Somaliland giraffe, an independent species (*G. reticulata*); a subspecies of "Cape" buffalo (probably *Bos caffer aequinoctialis*), which is certainly met with in the western, northern and southern parts of geographical Somaliland; besides other types referred to later in this review.

It may be that the author has preferred to restrict himself to such mammals as have been seen or obtained by himself. Yet he has been on the Juba River and in southern Somaliland, and fails to include in his list another most characteristic mammal of restricted distribution. Hunter's topi (*Damaliscus hunteri*), which from several points of view is like the vanished connecting-link which must have existed between the Bubaline group of antelopes and that of the Gazelline pallas (Æpyceros), just as Swayne's hartebeest suggests a resemblance to the intermediate types between the hartebeests and the gnus. Also, it is probable that among the mammals of Somaliland should be included the Gelada baboon (Theropithecus). The present writer has himself seen live specimens of Theropithecus (probably *T. obscurus*) in French Somaliland, pets of the engineers working on the Harrar railway, which were said to have been captured close by and brought in for sale by the Somalis. Also in this book no allusion is made to the almost certain existence of a Limnotragus tragelaph in the Webbe and other big rivers of Somaliland (*vide* Colonel Swayne's book, "Seventeen Trips through Somaliland").

But though there may be these omissions from a full and complete record of the mammalian fauna of the Somali country, Dr. Drake-Brockman gives excellent descriptions of nine-tenths of the known beasts of this still mysterious and insufficiently explored region (one of those portions of Africa with great discoveries in store for us concerning the past and present faunas of Africa). Also, he emphasises two points worthy of the attention of the League for the Preservation of the Fauna of the Empire (a league which fights despairingly against official apathy and the utter indifference of the overwhelmingly large majority of the British public, a public caring nothing about the fate of the dodo, of the Somaliland giraffe, of the English marten, or the Honduras ocellated turkey); and these two points are: (1) that the Somalis (for example), Midgans, and most other native tribes do not seriously ravage the big or small game of their country; and (2) that in spite of the meticulous game regulations (this qualification is the present writer's) there is a steady destruction of Grevy's zebras, oryxes, and numerous antelopes going on at the hands of European shooting-parties throughout Somaliland. We deduce from what this author says that the wild animals of British Somaliland of any notability must in some portions of the country be extinct. Probably officialdom does what it can. It is the nation from highest to humblest which wants converting to a right interest in biology.

Dr. Drake-Brockman has much of interest to say about the cheetah. He remarks on the much greater growth of mane in the cubs, their grey-white ground colour, and different black markings from those in the adult (a tendency to horizontal stripes instead of spots). He also adds to our knowledge of the life-history of the aard-wolf (Proteles), which he describes as secreting a foul-smelling liquid in glands near the base of the tail, and expressing this fluid secretion when attacked by dogs. According to his observations of the long-eared Otocyon "fox" (which, he says, is an easy animal to tame, and makes a delightful pet), this Eocene canine goes about in small packs rather than in pairs or singly. It seems to live a good deal on insect food. The Somali wild hunting dog (Lycaon) is smaller than the Lycaons of central and southern Africa, and has much shorter fur, is, indeed, inclined towards hairlessness—an interesting trait in view of a similar tendency in some varieties of *Canis familiaris*.

Of the Baira antelope (Beira is the accepted name, but is a misspelling of the Somali pronunciation) it is said that the females are slightly larger than the males. The author's excellent photograph of this peculiar Somali antelope emphasises its kinship with the klipspringer (Oreotragus).

As to the Somali waterbuck, is it really (as stated by Dr. Drake-Brockman) *Cobus defassa,* like that of equatorial East Africa, or an independent Somali species or subspecies? Colonel Swayne classed it as the *ellipsiprymnus* of South Africa, because of its grey-brown colour and the elliptical white mark on the rump. This is somewhat the description given by the present author; but *defassa* is, on the contrary, without a white mark on the rump, and is remarkable for its brilliant bay colour.

The Beisa oryx, the various gazelles of Somaliland —and if this is not *par excellence* "Gazelleland," what is?—the greater and lesser kudus, are all effectively

illustrated and described by Dr. Drake-Brockman. He tells us some new things about the long-necked, long-tailed dibatag (Ammodorcas) and gerenuk (Lithocranius), and about the oryx. In this last type (of which the book gives an excellent photograph) the reader is recalled to one of the problems of faunistic geography as yet unsolved, *i.e.* why is there such a strong affinity in mammalian and bird fauna, and to a lesser extent in flora, between south-west and north-east Africa, between Somaliland (in its largest geographical extent) and Trans-Zambezia? The Beisa oryx of north-east Africa and the Cape gemsbok are more nearly allied than either is to the fringe-eared oryx (*O. callotis*) of East Africa. In both north-east and south-west Africa we have ostriches, aard-wolves, otocyons, gazelles, foxes, black-backed jackals, secretary birds, striped hyænas, caracal lynxes, and cheetahs. North of the Zambezi and the Zambezi-Kunene line they do not exist, nor south of the Tana River and the Anglo-German frontier in Masailand.

There is even a slight correspondence (in these geographical extremes of Africa) in the affinities of the lowest human types. Linguistically, the only allies of the south-west African Hottentots are in equatorial German East Africa, and physically the only resemblances to the Bushman are to be met with in some of the Andorobo, Suk, and Doko helot tribes of north-east Africa, north and east of Unyamwezi and the Kilimanjaro district. Why should the connecting links of so many mammal and bird types have died out in between? The intervening regions were almost certainly covered down to quite recent times by dense forest, a forest only abated by the Neolithic negro. How did the "desert" types referred to of Somaliland and south-west Africa work their way through this forest-land across many degrees of latitude, and yet retain their peculiar adaptability (in colour as well as peculiarities of hoof and habit) for arid countries? A similar problem remains unsolved in regard to South America, in the south-western parts and southernmost extremity of which continent there are mammals related to North American types (such as Andean bear, the Antarctic wolf, and the Auchenia camelids) the nearest affinities of which are with North American forms, yet which to reach their present habitat must have traversed a greater or less breadth of densely forested, steamingly hot equatorial America. H. H. JOHNSTON.

SOME BRITISH FRESH-WATER PROTOZOA.

British Fresh-water Rhizopoda and Heliozoa. Vol. II. Rhizopoda, Part II. By the late James Cash, assisted by John Hopkinson. Pp. xviii+166+32 plates. (London: Ray Society, 1909.) Price 12*s.* 6*d.* net.

THE appearance of the second volume of this useful monograph of the British Rhizopoda was heralded some few months ago by the sad announcement of the death of the author, Mr. James Cash. The descriptions of the species and the beautiful plates which illustrate them were from the hand of the devoted and enthusiastic Manchester microscopist, and it will always be a matter for sincere regret that his life was not spared to see the completion of his work. To Mr. John Hopkinson we are indebted for the notes on synonymy, for the bibliography, and for the responsibility of seeing the volume through the press after the death of Mr. Cash.

The genera dealt with in the present volume are those included in the divisions of the Conchulina called by the authors the Difflugina and Nebelina. This leaves the treatment of the testaceous forms with filamentous pseudopodia and the Heliozoa to a third volume.

As pointed out in our review of the first volume (May 17, 1906), this monograph is one that is essentially systematic in its treatment. It includes the description of a number of forms which are considered by those who have made a special study of them to be specifically distinct or to be racial varieties of distinct species, but it does not attempt to deal with the more difficult problems of life-history and the influence of the environment. To the working microscopist who is anxious to find names for the varieties he discovers in the fresh-waters that he visits it will doubtless be of some value, for it gives him, in a convenient form and with excellent illustrations, a statement of the names that have been given to the varieties of Difflugia, Lesquereusia, Quadrula, and other well-known genera. But a purely systematic work of this kind cannot fail to raise in the mind of an inquirer many interesting questions that it altogether fails to satisfy. For example, of the genus Difflugia alone no fewer than twenty-three species are described, varying in length from 15μ to 250μ. Is there really any satisfactory evidence to prove that the smaller forms, such as *D. penardi* and *D. globulosa*, are not the younger stages in the growth of the larger forms? In the closely allied genus Centropyxis, Schaudinn has proved that the zygote formed by the fusion of a megagamete and a microgamete forms a small shell, but no one has, at present, described in detail the characters of the shells of the different stages of growth from the zygote until the full size of the adult is attained. Until this has been carefully done by the culture method, with two or three examples, the real value of the specific characters used in systematic treatises must be accepted with very great hesitation. In the meantime, it might be of some assistance to zoologists if a naturalist endowed with the skill and patience of the late Mr. Cash would give us a census of the Difflugia varieties or forms that are found in a particular pond or Sphagnum bog once for every month during a year or two. Such a census might, at any rate, suggest certain coincidences of occurrence which would be worthy of further investigation.

A few figures are given of two individuals "in conjugation" (*e.g. Difflugia oblonga,* p. 13, *Cryptodifflugia oviformis,* p. 79, *Nebela collaris,* p. 96), but the recent researches of protozoologists render it extremely improbable that a true process of conjugation occurs at all under such conditions as the figures indicate. It may be plastogamy or it may be a late stage of fission that has been observed, the absence of any indication of the nuclear structures in the figures rendering it impossible to form an opinion on this point, but there is really no reason to suppose that it is conjugation.

The volume is, as usual with the Ray Society's publications, well printed, copiously illustrated, and, thanks to the labours of Mr. Hopkinson, provided with very complete lists of reference to literature, and an index.

TECHNICAL CHEMISTRY OF SUGAR AND STARCH.

Traité complet d'Analyse chimique, appliquée aux Essais industriels. By Prof. J. Post and Prof. B. Neumann. Deuxième Édition Française entièrement refondue. Tome seconde, deuxième fascicule. (Paris: A Hermann et Fils, 1910.) Price 8 francs.

THIS edition of Post and Neumann's work is translated by MM. Pellet and Chenu from the third German edition. The particular fascicule now under notice deals with the chemical control of the manufacture of sugars and starches.

Beetroot sugar naturally claims the lion's share of attention in a Continental book dealing with sugar, and, by following the text in the case of this product, a good idea of the work as a whole will be obtained.

An outline of the process by which the sugar is extracted gives the reader in a page or two a general introduction to his subject. This leads to an exhaustive account of the various methods which are available for determining the quantity of sugar present in any solution of saccharine substances. Naturally, they are well-known processes—areometric, gravimetric, polarimetric, and volumetric; but they are well explained, both as regards theory and practice, and illustrated with figures of the requisite apparatus.

Coming next to the more specialised part of the work, we find, to begin with, detailed instructions for the testing of beetroot seed, and also specifications (German, Austrian, and French) of the conditions which the seeds are required to fulfil. Next follows a scheme for the analysis of the roots themselves, including full directions for those most important preliminary operations the sampling and pulping of the materials.

Having the pulp, what, precisely, is the best method of extracting the sugar from it? Much depends on this, and a full discussion of the *pros* and *cons.* of the various processes is entered into; namely, as to whether water or alcohol is the best solvent, whether it should be used hot or cold, and whether this or that *modus operandi* is to be given the palm for merit. Eventually the conclusion is arrived at, and supported by Dr. Herzfeld "*après de longues études,*" that extraction with cold water is in every way preferable to the use of alcohol for the purpose. It is simpler, easier, quicker, more economical, and more exact.

The samples of roots being analysed *secundum artem,* and the proportion of sugar duly determined, we pass to the *jus de diffusion* obtained in the actual manufacture. This is a weak aqueous solution of sugar and other soluble matter extracted from the roots by diffusion in water, and full directions are given for its examination. Next the syrups and massecuites are dealt with, modified processes of analysis being used, to suit their more highly saccharine nature; and eventually the finished products—the dry sugars and molasses—come under review. This, however, is not all; there is the question of by-products to be considered, including the best methods of utilising the residues from the pulp and molasses; and also there is the examination of the various materials, namely, water, chalk, carbonic acid, sulphuric acid, strontianite, and so on, that are used in the various stages of the manufacture.

These matters are all dealt with at length. Many figures of the necessary apparatus are given, and also several tables of numerical values which will much facilitate the analyst's work.

The remaining sections of the book, treating of cane-sugar, starch, dextrine, and glucose, are written in a similar practically useful manner. If in these industries, or in the future British beet-sugar production to which some hopeful eyes are turning, any chemist requires a laboratory handbook, he might do worse than study the one under notice. C. S.

PETROLEUM MINING AND OIL-FIELDS.

Petroleum Mining and Oil-field Development. A Guide to the Exploration of Petroleum Lands, and a Study of the Engineering Problems connected with the winning of Petroleum. By A. Beeby Thompson. Pp. xx+362. (London: Crosby Lockwood and Son, 1910.) Price 15*s*. net.

THE engineering part of the book contains a large amount of instructive information, especially in regard to customary procedure in Russian oil-fields, but the author betrays a lack of knowledge of recent practice in some of the American oil-fields. Thus, his remarks on steel wire cable drilling on p. 193 are misleading, for it is common knowledge that at the present time this system is certainly in favour in the United States, and may, in fact, be said to be generally used for deep wells in that country, often after a depth of 600 to 800 feet has been reached. Similarly, the statement made on p. 218, as to the method adopted when a dropped tool cannot be recovered by "fishing," ignores the usual practice of "side-tracking" by raising the casing and drilling off with a wedge. Again, on p. 238, the diameter of the last string of casing is understated, for American wells, started with a diameter of 12 inches or 14 inches, are frequently completed at a depth of 3000 feet, or even 4000 feet, with a diameter of 6 inches, and it is incorrect to state that in the United States the casing is always manufactured from mild steel, for wrought-iron casing is manufactured in that country and is readily obtainable. In the description of the process of cementing wells, on pp. 266–8, there is no mention of the latest and most effective system, which consists in pumping the fluid cement, without any admixture of sand, through tubing packed inside the casing, so that it circulates below the shoe and passes up on the outside of the casing, which is afterwards lowered and the packer withdrawn.

The description of fishing tools is a good and comprehensive account of these appliances, but generally the treatment of the engineering branch of the subject is unequal, and there is a predominance of the Russian practice, to which the author unconsciously

supplies the key-note by comparing some oil-sands with "fresh caviare" (p. 286).

In the chapter devoted to the geology, chemical composition and treatment of petroleum, the author is evidently less at home, and there are many statements to which exception might be taken. Thus the description of the structure of the Peruvian oil-fields (p. 53) is inaccurate, a series of anticlinals with intervening synclines being represented as a persistent monoclinal. The expression "concentration" (p. 59) for the flowing of oil to replace that which has been ejected with much solid matter in suspension is a novel one in this connection, and the same may be said of the terms "low density," "low resistance," and "high absorption," applied to the spaces vacated.

As the author fails to distinguish between benzene and benzine (pp. 132, 138), it is not surprising that he should assert that the frequency of association of petroleum with coal and lignite is "a source of speculation." Taking the Stock Exchange meaning of speculafion this may be true, but the frequency, even of adventitious proximity, still less of any causal relationship, is an obsolescent fallacy which it is not worth while to controvert afresh.

As this purports to be a practical work on petroleum mining and oil-field development, it is regrettable that greater judgment has not been displayed in the selection of the illustrations. Many of the plates add, no doubt, to the attractiveness of the volume, but convey no instruction. Amongst these are the photographic illustrations of groups of specimens of oil-rocks, bitumens, &c., a "mud-volcano" showing a level surface on which walking is being cautiously attempted, and a cart laden with Trinidad pitch.

More care should have been exercised in proofreading. Thus in the last line but one of p. 223 the word "for" should be "by," and, judging by the context, the word "not" has been omitted in the first line of the following page, the author being thus made to state the reverse of what he intended.

ESSAYS ON ANGLING.

Minor Tactics of the Chalk Stream, and Kindred Studies. By G. E. M. Skues. Pp. xii+133. (London: Adam and Charles Black, 1910.) Price 3*s*. 6*d*. net.

IT is long since we have read any book, written by an angler for anglers, with so much pleasure as Mr. Skues's "Minor Tactics of the Chalk Stream." The polemics of ardent advocates of the dry fly or the wet fly may instruct, and possibly convert, but they weary the reader; the object of the present book is to advance no theory, but to make the angler approach his subject (and his trout) with an open mind, and think out for himself the problems with which he is confronted. Herein, we conceive, lies the true value of the book. The scene is laid upon the banks of a chalk stream, or of some carrier in the water-meadows that holds dark, hog-backed trout; for setting we have the willows and lush herbage of a southern valley, while the reed warbler, the dabchick, and the corn-crake, are cast for minor parts; yet there is counsel which we would commend to those whose waters run through heather and bog-myrtle, where the trout are small, with fair golden bellies and ring-spotted sides, and the angler's music is the sweet spring cry of the curlew or the drumming of the snipe.

It is of the essence of Mr. Skues's teaching that the angler should cast aside the dogmas of his predecessors, and should study nature for himself; nature as seen in the trout, and on the banks of the stream, and, above all, in the life-histories of the insects eaten by the trout. There is no dogmatism here, but a pleasant didactic manner, instructing while it amuses, and amusing when it does not instruct; the moral is pointed by tales of full baskets or of bad days (our author's methods seem to have eliminated blanks), and there are constant reminders that bring the reader from his theories straight back to the river's bank. We may learn how to tie flies in imitation of the nymphs of Ephemerids, and how to fish with them, of an effort to reproduce the alder-fly lava and its results, and of the sad fate of the artificial fresh-water shrimp; we may further read of the undoing of trout that bulge or tail, of trout that live in strange and unapproachable holes, and of those gourmet trout whose tastes need humouring.

The temptation to quote from Mr. Skues is irresistible, the difficulty is to select; whether to reproduce his tale of the day on which there was no rise of fly but a strong rise of water-rats, or his comments on flies, or on human nature and its reluctance to jeopardise a shilling cast and twopenny fly for the sake of getting a fish out of some weedy or bushy hole. Here, for instance, is one comment with which we cordially agree:—"Indeed, why a trout should take any artificial fly is a puzzle to me. The very best are not really very like the real things. One thing is clear: It is not form which appeals to the trout, but colour and size." In the light of this passage, the flies shown on the frontispiece should be studied and compared with the actual flies and nymphs.

Throughout the book the same ruling idea is found; the preaching of no system, the upholding of no tradition, but a plea for "unfettered judgment, independence of tradition, and, above all, the inquiring mind." We wish Mr. Skues success in his campaign; incidentally we wish him many readers, and we wish his readers many more such books as this. But when these books come let them be indexed; good advice is elusive, and captions alone are not always sufficient guides.

L. W. B.

ZOOLOGICAL STUDIES.

Studies from the Zoological Department, University of Birmingham. Vol. ii. Edited by Prof. F. W. Gamble, F.R.S. (1910.)

THIS volume consists of reprints of sixteen papers from various journals, the outcome of work done in the years 1905–9 by the staff and students of the zoological department of the University of Birmingham. It is appropriate that the first paper in the volume should be one by the late head of the depart-

ment—Prof. T. W. Bridge—and that it should deal with a subject which he had made peculiarly his own, namely, the air-bladder of fishes. The main purpose of this interesting paper is to consider this remarkable organ, not from the points of view of morphology and function, though these aspects are not neglected, but as the source of isinglass. The author pointed out that, although there are 7000 or 8000 species of fishes with air-bladders, few are utilised for the supply of isinglass, and he suggested that the air-bladders of some of our larger British food-fishes, such as the cod, hake, gurnard, &c., might be of value for this purpose. Isinglass is apparently the only product of the animal body which can be used as a clarifying agent in brewing operations, and its mode of action does not seem to be at all clearly understood, but it is believed that it depends on the fibrous nature of the substance. The fibres swell out in the liquid, particles become entangled in their meshes, and are carried, with the settling of the isinglass, to the bottom of the barrel.

There is one other contribution from the pen of the late Prof. Bridge, probably his last published work, on the presence of a false acetabulum in a Bandicoot. Dislocation of the head of the right femur resulted in the formation of a false socket on that side of the pelvic girdle, dorsal to and closely resembling the normal acetabulum, which latter had undergone retrogressive modification as the result of the loss of function.

Half the remaining papers in this volume are concerned with fishes—Mrs. Merritt Hawkes records the presence of a vestigial sixth branchial arch in the Heterodontidæ, describes the cranial and spinal nerves, the abdominal viscera, and a vestigial seventh branchial arch of Chlamydoselachus, and gives a useful account of the theory of nerve components; Mr. A. D. Imms describes the gill-rakers of the spoonbill, and the oral and pharyngeal denticles of Elasmobranchs; and Mr. R. H. Whitehouse discusses the morphology of caudal fins, directing attention to the effects of specialisation, especially abbreviation, of the axis and restriction of the caudal fin in homocercal tails, and concluding that the present homocercal caudal fin is really a posterior anal which owes its present position to the great abbreviation of the axis coupled with excessive upturning of the end of the chorda.

There are further contributions from Mr. Imms on Anurida (being his L.M.B.C. memoir on this Collembolan), and on the occurrence at Port Erin of a pseudo-scorpion (*Obisium muscorum*) in the fissures of rocks in such positions that the specimens had to endure submersion twice daily. The studies also include papers on sex-inheritance in the moth *Abraxas grossulariata* and its variety *lacticolor*, and on animal parthenogenesis, by Mr. L. Doncaster; on the anatomy of the "green fly" of rose trees by Mr. A. J. Grove, and on the gonadial grooves of Aurelia by Mr. T. Goodey.

The studies bear testimony to the range of view of the late professor and to his stimulating influence on his pupils.

OUR BOOK SHELF.

Physiology of the Special Senses. By M. Greenwood, Jun. Pp. vii+239. (London: Edward Arnold, 1910.) Price 8*s*. 6*d*. net.

IN trite phraseology, this book supplies a long-felt want, and supplies it in a manner which is altogether commendable. It is elementary, but not so elementary as merely to traverse the same ground as that covered inefficiently in so many text-books. In reading the chapters devoted to the special senses in many text-books of physiology, one feels irresistibly that the author is out of sympathy with the subject. In this book the physiology of the special senses is introduced to the reader with illuminating clearness born of thorough knowledge and judicial discrimination. The requirements of the student are catered for by a teacher who knows how to interest his audience, but at the same time demands an attentive application of intelligence. Thought is stimulated, and the desire for further knowledge evoked. Each chapter concludes with a short but well-selected bibliography, pointing out the path for further study.

After an introduction dealing with the laws of Müller, Weber and Fechner, cutaneous sensation, taste and smell, the sense of position and movement, hearing, vision, and the physiology of space come successively under review. The work of Head and his collaborators, Rivers, Sherren, Ham and Thompson, upon protopathic and epicritic sensibility is clearly described, whilst the subsequent researches of Trotter and Davies are discussed and criticised. Taste and smell, the sense of position and movement, and hearing are adequately treated, but, as was to be expected, the physiology of vision in its manifold and complex manifestations demands the major part of the book, more than half the pages being devoted to its consideration.

After a chapter on the comparative physiology of vision, retinal processes, electrical, phototropic and chemical responses are dealt with. The student is led on in logical sequence to visual adaptation, entailing a discussion of peripheral vision and total colour-blindness. The chapter on recurrent vision theories of adaptation gives the reader ample food for reflection, and in entering upon the thorny subject of trichromatic vision the author wisely quotes the warning words of Helmholtz:—"The confession of actual doubt is better than the delusion of dogmatic certainty."

The treatment of colour-vision and colour-blindness is admirable. Expanded and treated more exhaustively in the same judicial spirit it might form a valuable corrective to the obsessions which the subject seems almost inevitably to induce. Further chapters are devoted to after images, historical theories of vision, the Young-Helmholtz theory, Hering's theory, and simultaneous contrast.

Reminiscences of a Strenuous Life. By Prof. Edward Hull, F.R.S. Pp. iv+119. (London: Hugh Rees, Ltd., 1910.) Price 4*s*. 6*d*. net.

THOUGH nothing appears in this simple record to justify the adjective in the title, it will afford to many a pleasant reminder of a life still keen and active, yet bridging the years between Thomas Oldham's lectures in Dublin and the Darwin celebration of 1909. Dr. Hull originally studied at Trinity College, Dublin, with the view of becoming a clergyman of the Church of Ireland, and it is interesting to note that a course in the Irish language then formed a part of the recognised curriculum. Having, however, been attracted by engineering, he came under Oldham's influence, and, with his aid, began work on

the staff of the Geological Survey of Great Britain. His chief was Sir Henry de la Beche; his first instructor in the field was J. Beete Jukes; and during the next fifty years he became acquainted with all the prominent geologists in our islands. His principal official work was in connection with the Irish branch of the Survey, of which he became director in 1869. Some of the controversies of the next twenty years may have been "strenuous"; but Dr. Hull gives only a bare hint of this. In a kindly spirit he dwells on the many friends he made, a large number of whom are fortunately still amongst us. There is an engaging *naïveté* about some of his anecdotes, as when he confesses (p. 27) that he was shocked to find that one of these friends was a Liberal; or when he mentions that he lectured on a biblical subject with an archbishop in the chair. But his reminiscences of scientific societies in Dublin will come home to all those who remember the old friendly gatherings, which have already grown a shade more formal, partly through the spread of suburban homes, and partly through the development of more "strenuous" and specialised activities.

Dr. Hull's geological expedition to Arabia Petræa and Palestine has been described elsewhere, and is here only lightly touched on. An abstract is given of his work on the submerged valleys of the European plateau (p. 105); but we miss a mention of the fact that, under his direction, the geological survey of Ireland was completed on the one-inch scale before his retirement in 1890, every sheet being accompanied, as Jukes had planned, by a descriptive memoir. These geological memoirs may vary a good deal in their degree of completeness, but their publication was very systematically carried on. We probably owe to Dr. Hull the delicate and artistic colouring of the northern sheets of the Irish Survey, which made them absolutely without rivals, until stronger tints were used in recent years. In spite of the evidence of the present reminiscences, it is hard to realise that Dr. Hull's official career ended, after full years of service, close on twenty years ago. A good portrait and a bibliography accompany the volume.

Catalogue of Bronzes, &c., in Field Museum of Natural History. Reproduced from Originals in the National Museum of Naples. By Prof. F. B. Tarbell. (Chicago: Field Museum of Natural History, 1909.)

THIS publication constitutes a fascicle of the seventh volume of the anthropological series of the Field Museum of Natural History, Chicago. The objects described in this "Catalogue" are reproductions in bronze of originals in the National Museum of Naples from the Campanian cities buried by the eruption of Vesuvius in 79 A.D. With a few exceptions "these objects constitute a fairly representative selection from among the bronze utensils, instruments, and articles of furniture in the great Neapolitan collection; and, while not exact in every particular, they do, nevertheless, give a fairly correct idea of the originals." As no complete and scientific account of the Naples bronzes "has ever been issued, it has seemed worth while to prepare a somewhat detailed catalogue, with illustrations, of these reproductions." The catalogue enumerates and describes with considerable detail some 300 different objects, of which seventeen are designated "pre-Roman," and illustrates almost the entire series in 117 excellent plates. To archæological students and such other Americans as may have no opporunity of visiting Naples, these reproductions will be almost as valuable as the originals, and from them the museum will receive grateful acknowledgment, both for having had the reproductions made and for this excellent account of them, of which European students will not fail to appreciate the value when in face of the original collection in Naples.

The Building and Care of the Body. An Elementary Text-book in Practical Physiology and Hygiene. By Columbus N. Millard. Pp. x+235. (New York: The Macmillan Company, 1910.) Price 2s. 6d.

As Mr. Millard says in his preface, teaching pupils how to develop strong, healthy bodies should be one of the chief aims of our schools. One of the objects of his book is to convince children that certain practices are likely to make them happier and more comfortable, abler in play and work, and so lead them to regard the study of the laws of health as worth while. The author has already made a favourable impression among teachers in this country by his earlier book, "The Wonderful House that Jack Has," and the present volume is likely to prove useful, since it provides brightly written and well-illustrated lessons on the simple facts of human physiology and hygiene.

The English Lakes. Described by A. G. Bradley. *Canterbury.* Described by Canon Danks. *Oxford.* Described by F. D. How. All pictured by E. W. Haslehurst. Each pp. 56. (London: Blackie and Son, Ltd., 1910.) Price 2s. net each.

THE first three volumes of a series designed to bring before readers the beauties of England are certainly very attractive books. The text is interesting, touching lightly history, geography, archæology, and any other subject able to contribute facts or fancies likely to arrest the attention. We imagine the volumes are not intended to serve any serious purpose; but though unsuitable for guide-books, they will certainly become favourites with lovers of the districts they severally describe.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Temperature Conditions within Clouds.

AT the meeting of the British Association for the Advancement of Science held in Winnipeg last August, a paper was read before the Physics Section by Prof. A. Lawrence Rotch, director of the Blue Hill Observatory, in which a rise of temperature was described as having been recorded by a *ballon-sonde* meteorograph in passing through a cloud. In the discussion which followed considerable doubt was expressed as to the possibility of such a condition existing. That there was an increase in temperature recorded by the meteorograph as it passed upward through the cloud there can be no doubt (see diagram in *Meteorologische Zeitschrift*, December, 1909, p. 554). Dr. John Aitken, in NATURE of November 18, 1909, says that he sees no reason to question the truth of the record, for he has on numerous occasions observed similar increases of temperature while enveloped in a cloud upon the summit of a mountain. He directs attention to the fact that great caution must be exercised in obtaining temperatures under these conditions, for, on account of the excessive radiation that occurs within the cloud, unless the instrument is sufficiently insulated from the heat rays, the thermogram will be vitiated. In the case of the ascent referred to, the increase of temperature was not unreal, for due precaution, in the form of an especially prepared insulator, had been taken to eliminate the effects of radiation, and the ventilation was sufficient.

In order to determine the temperature conditions within and about clouds for a large number of cases, an examination was made of the records obtained in the kite-flights

made at Blue Hill Observatory. These data are particularly valuable for such a study, since in each flight continuous records of temperature, pressure, humidity, wind-velocity and direction were obtained for all heights reached by the uppermost kite, below which the meteorograph is attached to the wire. In the kite meteorograph used, the thermometer and the hair-hygrometer are screened as much as is possible, thus rendering the heat received from radiation a negligible amount.

A total of sixty-four kite flights were found in which the meteorograph penetrated a cloud, and, since in six of these flights two cloud-sheets were encountered, the temperature conditions in seventy cloud-strata were obtained as a basis for the investigation. Of these, 63 per cent. showed a rise in temperature of 3·0° F. or more in the upper part of the cloud or immediately above it, 23 per cent. showed no apparent effect of the cloud on the temperature conditions, 7 per cent. showed an inversion below the base of the cloud, while the remaining 7 per cent. showed an isothermal condition prevailing from the base to the summit of the cloud. The flights in which the records

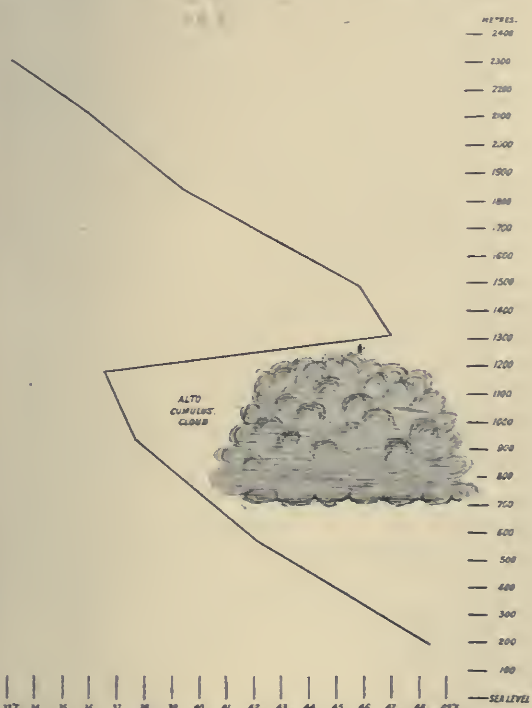


FIG. 1.—Curve of November 3, 1904, showing increase of temperature occurring within and above cloud.

were obtained were distributed with fair uniformity throughout the year, and the clouds encountered represent all kinds except cirrus and cirro-stratus, these having rarely been penetrated. Moreover, although by far the greater number of flights were made in the daytime, many flights at night are included.

In the largest of the four groups, namely, the one including the flights which showed a rise in temperature in the upper part of the cloud or immediately above it, the increase usually began about half-way between the base and the summit, and persisted until the maximum temperature for the inversion was reached a short distance above the uppermost part of the cloud. Beyond that point the usual rate of decrease, approximately the adiabatic rate for dry air, prevailed as high as the kite ascended. In the next largest group, that including flights in which the cloud had no apparent effect on the temperature conditions recorded, a fairly regular rate of decrease, somewhat similar to the adiabatic rate for saturated air, was found. In the next group, that including cases in each of which there was an inversion below the cloud, the increase in temperature persisted throughout the cloud and to various heights above it, where a decrease again began. In every one of these cases there were the characteristic cyclonic conditions of a shallow easterly wind at the ground overlaid by a warm south-west wind, with precipitation following. It is thus evident that the increase in temperature was caused by the importation of relatively warm air, and hence began at a height independent of the cloud, the latter only reinforcing the larger warming. In the smallest group, that including the five cases in which there was a practically isothermal condition throughout the cloud, the distinguishing characteristic was really that of the largest group, for, since the usual condition in the lower free air is that of a fairly uniform decrease of temperature approaching the adiabatic rate for dry air, an isothermal state is theoretically equivalent to an increase of temperature with increasing height, such as characterise the cases of the first group. If this be granted, 70 per cent. of the instances show an increase of temperature in the upper part of the cloud and beyond for a short distance.

This phenomenon of an increase of temperature is entirely independent of the difference in the adiabatic rates of dry and of saturated air, that for the latter being about one-half that of the former. The marked decrease in

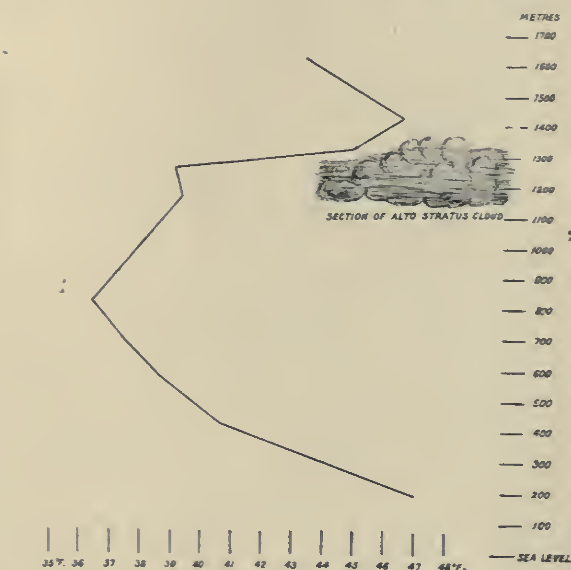


FIG. 2.—Curve of April 4, 1905, showing increase of temperature beginning below cloud.

relative humidity almost always occurring just above a cloud is probably simply the result of the increased temperature. Dr. Shaw, the director of the English Meteorological Office, in discussing the thermal relations of floating clouds, says:—" A floating cloud, a finite mass of air carrying water particles, is losing by radiation into space (at night) through the clear air above it more heat than it receives from the earth beneath; the water globules will, in consequence of this loss of heat, evaporate, and the cloud will vanish " (Quarterly Journal of the Royal Meteorological Society, vol. xxviii., 122, p. 95). It is also worthy of note that in a balloon voyage made in Germany recently, not only was there noted a " warming above the cloud, or at least above the lowest plane of formation," but an increased temperature was recorded in a stratum of ordinary haze (Elias and Field, Quarterly Journal of the Royal Meteorological Society, vol. xxxi., 134, p. 125).

ANDREW H. PALMER.

Blue Hill Observatory, Hyde Park, Mass., May 5.

Eddy Formation—A Correction.

IN Prof. Bryan's solution of the problems in eddy formation (NATURE, February 3, p. 408) no mention is made of the fact that a vortex in one plane at rest, when the method of conformal representation is used, does not in general lead to a solution in which the corresponding vortex is at rest.

Taking a single vortex at $z=z_0$ at rest, let

$$w=im\log(z-z_0).$$

Transform by putting $z=f(t)$, and let $z_0=f(t_0)$,

$$\begin{aligned} w&=im\log\{f(t)-f(t_0)\} \\ &=im\log(t-t_0)+im\log\left\{f'(t_0)+f''(t_0)\frac{t-t_0}{2}\ \ldots\right\} \end{aligned}$$

expanding in the neighbourhood of $t=t_0$, and at the vortex

$$\frac{dw}{dt}=im\frac{d}{dt}\log(t-t_0)+\frac{im}{2}\frac{f''(t_0)}{f'(t_0)},$$

the first part giving the velocity due to the vortex itself and the second the motion of the vortex. The vortex will not be at rest unless $f''(t_0)=0$.

Employing Prof. Bryan's method to obtain a solution giving a vortex at rest in the t plane in the cases considered by him, with the vortex in the z plane not necessarily at rest, we have

$$\begin{aligned} w&=Uz+im\log\frac{z-a-ib}{z-a+ib} \\ z&=f(t) \\ a+ib&=f(t_0. \end{aligned}$$

Then the velocity at any point is given by

$$\frac{dw}{dt}=\left\{U+\frac{im}{z-a-ib}-\frac{im}{z-a+ib}\right\}f'(t).$$

At the vortex the motion is given by

$$\frac{dw}{dt}=\left\{U-\frac{im}{zib}+\frac{im}{z}\frac{f''(t_0)}{[f'(t_0)]^2}\right\}f'(t_0),$$

omitting the infinite term due to the vortex itself. If the vortex is at rest,

$$U-\frac{m}{zb}+\frac{im}{z}\frac{f''(t_0)}{[f'(t_0)]^2}=0 \quad . \quad . \quad . \quad . \quad (1)$$

and if the velocity at $z=0$ in the z plane vanishes,

$$U-\frac{zmb}{a^2+b^2}=0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Prof. Bryan's first transformation is $z=t^n$, so the condition (1) becomes, since $t_0{}^n=a+ib$,

$$U-\frac{m}{zb}+\frac{im}{z}\frac{n-1}{n(a+ib)}=0 \quad . \quad . \quad . \quad . \quad (1)$$

If n is not unity, (1) and (2) give

$$n=\tfrac{1}{4},$$

which lies outside the prescribed limits of n. Consequently no solution of this type can be obtained giving a vortex at rest.

Prof. Bryan's second transformation is

$$Z=\sqrt{c^2+t^2}.$$

Condition (1) becomes in this case, since

$$c^2+t_0{}^2=(a+ib)^2,$$

$$U-\frac{m}{zb}+\frac{im}{z}\frac{c^2}{(a+ib)\{(a+ib)^2-c^2\}}=0 \quad . \quad . \quad (1)$$

which gives

$$a(a^2-3b^2-c^2)=0 \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$U-\frac{m}{zb}+\frac{mc^2}{2b\{3a^2-b^2-c^2\}}=0 \quad . \quad . \quad . \quad . \quad (4)$$

Equations (3), (4), and (2) cannot be satisfied by any values of a, b, and m. A solution of the two-dimensional problem of liquid impinging at right angles on a plate of finite breadth with two stationary vortices at the back of the plate and finite velocities at the edges is impossible.

E. H. HARPER.

MR. HARPER is quite right. It would appear from his investigation that it is impossible to apply the transformations in question to fluid motions with stationary vortices, notwithstanding that a vortex transforms into a vortex, and a fluid particle *other than a vortex* which is at rest transforms into a particle also at rest. It is a pity that this fact was overlooked, and that results were consequently published which are of less interest than was supposed at the time.

G. H. B.

The Nutritive Value of Black Bread.

IT appears to me that the contributor of the article on this subject in NATURE of May 5 has overlooked one all-important question, viz. how much of the nitrogen present in each form of bread is actually digested.

I had occasion to look up this question last year, as I happen to be a politician who *is* "particular about his facts," and I agree with your contributor in detesting "allegations," political or otherwise, that are "wanting in scientific accuracy." I referred, accordingly, to Wynter Blyth's "Foods: their Composition and Analysis," and found on p. 173 a table showing "the amount of dry substance, &c., absorbed in percentages of" (*a*) North German black bread (*Pumpernickel*) made of whole rye meal with leaven; (*b*) Munich rye bread, which is a mixture of rye and coarse wheat meal, with leaven; (*c*) white wheaten bread.

The percentages absorbed were:—

	Dry substance	Nitrogen
(*a*)	80·7	57·7
(*b*)	89·9	77·8
(*c*)	94·4	80·1

"It is thus shown," says Wynter Blyth, "that of the black bread a person would have to eat very much more than of white bread." I worked out the corollary of these facts in a letter published in the *Western Daily Mercury* of February 18, 1909, and showed that, on the basis of these analytical results, it would be necessary to eat 8 lb. of *Pumpernickel* to obtain the nitrogenous nutriment afforded by $5\frac{3}{4}$ lb. of wheaten bread.

My copy of Wynter Blyth's book was published in 1888, and his results are quoted from G. Meyer's experiments. It is, of course, possible that during the last twenty years Meyer's results may have been proved wrong, and that pure rye bread has been proved to yield as much *digestible* nitrogen as wheaten bread yields. Should this be the case, I shall be much obliged by information as to the latest and most trustworthy experiments.

FRANK H. PERRY-COSTE.

Polperro, Cornwall, May 16.

THE criticism is quite to the point, but is not the last word to be said on the subject. It is well known that in the digestion of whole-meal breads there is larger waste; but, on the other hand, if in the initial material there is a greater amount of certain constituents, then, in spite of a larger percentage waste, the actual quantity of these ingredients utilised in the body may be greater. In Rubner's experiments, cited in "Standardisation of Bread. Bread and Food Reform League," this was found to be the case. The percentage of nitrogen absorbed from white flour being 79·93, and that from whole meal being only 69·53, nevertheless the actual amount absorbed from equal weights of the two materials was larger in the case of the whole meal, and this was even more marked with the fat and the inorganic constituents; but at the moment I am unable to find similar analyses relating to black bread itself.

THE WRITER OF THE ARTICLE.

Native Tantalum.

SINCE the communication by Mr. P. Walther regarding native tantalum from the Ural Mountains was published in NATURE of September 16, 1909 (p. 335), another small quantity of a few dekagrams of native tantalum has been recognised in the collection of the deceased mining director, having been collected from the Altai Mountains. It was found in very similar circumstances, and at about the same time, as the tantalum from the Ural Mountains. The difference is in the impurities; the Altai tantalum contains gold from a slight trace to 0·0095 per cent., but no trace of manganese, tin, and niobium could be detected; the latter three have been found in the Ural tantalum. The average percentage of tantalum is 98–99 per cent. The average measurement of the crystals is about 0·1 mm., and the crystals are of the regular system, as in the Ural tantalum. The hardness (between 6 and 7) and the specific gravity (11·2) are the same. The specific gravity mentioned in NATURE of September 16, 1909, has been found too low, the error being due to air bubbles.

Newcastle-on-Tyne.

W. VON JOHN.

THE RECENT ERUPTION OF MOUNT ETNA.

EVERY eruption of Mount Etna since 1883 has taken place on its southern slope. The eruption of 1883, which was preceded and accompanied by very severe earthquakes, caused a radial fracture, running roughly from north to south, from the central crater to an altitude of 950 metres on the aforesaid slope; but that eruption was abortive, only lasting three days, and forming very small craters and insignificant flows of lava.

The eruption of 1886 took place on the same fracture of 1883, without any severe earthquakes. A large crater was formed, a great mass of lava was expelled, and the eruption lasted twenty days.

The eruption of 1892, on the same fracture of 1883, was preceded and accompanied by a few slight earthquakes; it formed four large craters and other small craters, emitted still more lava than the eruption of 1886, and lasted six months. Thus during these two eruptions it appeared that the lava found a passage prepared, whence its emission was easy.

During the month of April, 1908, there was an eruption on the eastern slope of the Valle del Bove; it was accompanied by a few slight earthquakes, but no raised craters were formed, little lava was expelled, and the disturbance lasted less than twenty-four hours. Evidently this also was an abortive eruption, probably because (as it did not take place on the fracture of 1883) it found no free opening for the emission of the lava, and met instead the unyielding rocks of the higher parts of the Valle del Bove. If we consider only the eccentric eruptions, those which have taken place since 1883 (including the recent eruption, which, as will be seen, is on the same radial fracture as the others), we find the following figures approximately giving the altitudes of the middle of the eruptive areas :—

Eruption of 1883:	altitude 1050 m.		
,, 1886:	,, 1450 m.;	difference	400 m.
,, 1892:	,, 1850 m.;	,,	400 m.
,, 1910:	,, 2175 m.;	,,	325 m.

This suggests, therefore, that successive eruptions break out on the same fracture, but each higher than the last. This is easily explained by the fact that the lava of an eruption, tending to flow down, within and upon the fracture, closes it in the lower part, and leaves it more or less open in the higher, where, consequently, another eruption may be produced more easily.

We now come to the recent eruption. From the early hours of March 23 until 8h. 15m. a.m., the seismographs of the Observatory of Catania registered many slight shocks, which followed one another almost continually. Of those which in the large seismograph had an amplitude ($2a$) greater than 1 mm., there were twelve, the severest of which ($2a=13$ mm.) took place at 2h. 55m. a.m. But even this last shock was not felt by the inhabitants of the villages nearest the place of the eruption, so that it did not raise any alarm. These circumstances, together with the fact of its being night and everyone asleep, prevented anything abnormal being observed on the volcano until 8h. 15m. a.m. At this hour, rising above the mist and above the Piano del Lago, a thin column of steam was seen, widening at the top and taking the characteristic form of a pine (*Pinus italicus*). In fact, a large fracture had been formed, having a length of almost 2 kilometers, from Monte Castello to the western base of the Montagnola, in the direc-

FIG. 1.—Eruption of Etna seen from the heights N.-N.E., April 4, 1910. Photograph by Assistant L. Taffara.

tion of N.N.W., between the height of 1950 metres and 2400 metres, and on the old fracture of 1883.

In the new fracture were a great number of craters, which emitted lava, bombs, incandescent lapilli, and clouds of steam and dust (Fig. 1). At first the lava issued from the highest point, and formed a small stream going towards the south, which had the length of nearly two kilometres, but afterwards the principal emission was from the lower craters, from which a perfect river of molten rock, fifty metres wide, rapidly descended towards the south (Fig. 2). When it reached the east side of Monte Faggi, at a distance of two kilometres from these craters, having found a narrow passage between the above-mentioned mountain and the first lava of 1892, it formed a magnificent fiery cascade, ten metres wide and twenty metres in height (Fig. 3). Then it flowed on towards S.S.W., passing Mount Sona on the east, then towards the south, going through a gorge between Mount San Leo and Mount Rinazzi. Beyond the obstacle formed by this gorge, the rate of movement of the lava-stream diminished, owing in part to the fact that the slope of the ground is less, but the lava spread out considerably; in fact, from the lower craters to the cascade the lava-stream is no more than 100 metres wide, but from the cascade to the gorge above mentioned its width reaches half a kilometre; below the gorge the width even reaches one kilometre.

The depth of the lava varies from a few metres to a hundred metres in some places. The lava reached the lowest point near the Cisterna della Regina, ten kilometres from the new craters, on April 6.

FIG. 2.—Lava flowing from lower craters on Etna Photograph by Mr. W. Schlatter.

FIG. 3.—Eruption of Etna on March 29, 1910. Lava fall from S.E. Photograph by A. Riccò.

The higher streams continued to flow and extend until April 20, when the flow of lava ceased, and the eruption was at an end. It had, therefore, lasted twenty-nine days.

A. RICCÒ.

THE ETHNOGRAPHY OF SOUTHERN INDIA.[1]

COCHIN has now followed the good example of the neighbouring South Indian States, Mysore and Travancore, in carrying out a survey of its population. The account of the survey, conducted by Mr. L. K. Anantha Krishna Iyer, will ultimately consist of three volumes. The first, devoted to an account of the forest and other low-caste tribes, has now appeared, to be followed by a second describing the higher castes, and a third dealing with physical anthropology. The work is, on the whole, a creditable performance, and it is illustrated by a good series of photographs. More precision in the matter of quotations and references is to be desired. With the last census report of the State the student will now possess ample information regarding the people.

The work is introduced by Dr. J. Beddoe, who discusses recent contributions to Indian ethnology. His note is followed by an essay from Dr. A. H. Keane, in which he propounds his views on the origin of the races of India. Criticising the conclusions of Sir H. Risley, he lays down four principles. First, that there is no fundamental unity in the people, "the superficial uniformity of physical characters being far less than is commonly supposed, and due not to a fanciful primordial unity, but to secular interminglings of several originally distinct ethnical groups superinducing surface resemblances." Secondly, that the assertions of

1 "The Cochin Tribes and Castes." Vol. i. By L. K. Anantha Krishna Iyer. Pp. xxx+366. (Madras: Higginbotham and Co.; London: Luzac and Co., 1909.)

classical Hindu writers, claiming racial unity, are worthless, being mainly in the interest of the "twice-born" and priestly class. Thirdly, that there are five primary stocks out of which the present population has been formed—Negrito, probably derived from Malaysia; Kolarian, Dravidian, and Aryan, who arrived in the order named from beyond the northern mountain ranges; lastly, the Mongol, now mainly confined to the Himalayan slopes. Fourthly, that three groups, Kolarian, Dravidian, and Aryan, are represented by distinct linguistic stocks, and that hence compound terms, like the Indo-Aryan, Dravido-Munda, and Scytho-Dravidian of Sir H. Risley, are meaningless, if not actually misleading. It is needless to say that, perhaps with the exception of the second, these principles will be disputed by various Indian ethnologists. The fact is that the collections of physical measurements in India itself, and still more from border lands, are at present insufficient for a settlement of these tangled problems.

Among the many interesting topics discussed by Mr. Iyer, perhaps the most valuable is his account of the Oti black magic of the Parayans, by which the adept believes that he can acquire the power of transformation into an animal, of causing and curing disease, and so on. It is, however, unlikely that the sorcerer, being here both priest and intercessor, settles the relation of magic to religion.

The Kanizans' Prayers before Prediction. From "The Cochin Tribes and Castes."

Much information is provided on the subject of the social relations of these outcast tribes. Probably owing to their protection from the inroads of foreign invaders, the Hindus of South India, whose example has been followed by the outcasts, surround themselves with a number of tabus in regard to the pollution by touch, the use of common food, and the like, much more stringent than those which are in force among the northern races. For instance, the Kadars, primitive dwellers in the forests, are contaminated by the touch of a Malayan, a cognate tribe. The educated Madrasi is prone to accuse the Anglo-Indian of race insolence in restricting social intercourse with him, while he himself, in his dealings with the lower tribes, is much more restrictive. Thus even the presence of a Pulayan in a town or market is considered a source of defilement, and "they are shunned as if infected with plague"; the Valan, when on a public road, has continually to call out so that the higher castes may avoid him; a Nayadi pollutes a Brahman by approaching within a distance of three hundred paces, and a priest can purify himself only by renewing his sacred thread, bathing, and consuming the five products of the sacred cow. Mr. Iyer, with some regret, admits that this policy is naturally driving the outcasts into the arms of the Christian missionary, conversion immediately elevating them in the social scale, and placing them on a level with their new brethren. It is clear that if Hindus desire to secure Anglo-Indian sympathy, and retain these people within their religious organisation, they must set their own house in order, and must lose no time in joining the new association, which has received the patronage of the Guicowar of Baroda, and aims at more considerate treatment of the depressed races, of which the present book gives a comprehensive description.

SHEFFIELD MEETING OF THE BRITISH ASSOCIATION.

As announced already, the British Association will meet this year in Sheffield under the presidency of Dr. T. G. Bonney, F.R.S. Members of the association who have not seen the city since the last meeting there thirty-one years ago will find themselves now quite at sea, so great have been the changes in streets, buildings, growth, and, it may be added, public spirit during that time. It has now been found possible not only to provide ample accommodation for the sectional work, but to do so compactly, all the sections except one being within a few minutes' walk from the reception room. The reception, smoking, writing, and general committee rooms will be housed in the suite of assembly rooms belonging to the Cutlers' Company, which were used in 1879 for the evening soirées. The reception room of that date is now allotted to Section E. The Cutlers' Hall is also close to the tramway centre, and so is easily accessible from all parts of the city.

The evening discourses are to be given in the Victoria Hall, a place easy to speak in and easy to hear in. The Lord Mayor (Lord Fitzwilliam) will give a soirée at the Town Hall, and the Chancellor of the University (the Duke of Norfolk) one at the University. The latter is to be associated with an evening garden-party in the Weston Park, which surrounds the University, to be given by the local committee. A series of garden-parties is being arranged, of which one will be given by Lord and Countess Fitzwilliam at Wentworth. Among others, excursions are already arranged to Chatsworth and Haddon, The Dukeries and Birchinlee, in the heart of the wild Peak country, where huge reservoirs are being constructed for the water supply of Sheffield, Derby, Nottingham, and Leicester. The latter are a portion of the development which is rapidly transforming the district round the Peak into a lake country, the valleys running down from the high moors being dammed to form, in many cases, extremely picturesque sheets of water.

The various committees engaged in making the arrangements are determined to make the meeting a success so far as they are concerned. The scientific success will depend on the association itself. A large attendance of members is expected, not only because

of the local attractions, but because a meeting in the colonies has generally been followed by a large meeting at home. Few places have industries the operations of which afford such interest to visitors. To see an armour-plate rolled or the forging of some huge mass of red-hot metal is a sight for a lifetime, whilst the variety of the industries engaged in some form of steel-making or silver-plating is very great. Arrangements are being made whereby a large number of the more important works will be open for inspection by members.

It is generally supposed that Sheffield is a sort of city of dreadful night, and that it and smoke are convertible terms. This is, however, a complete delusion. Few cities of its size have more delightful suburbs or such picturesque scenery in the neighbourhood. The city stands at the confluence of five valleys, with contributory streams to the Don. The ridges between rise sharply to 900 feet above it, and then run up to the grouse moors, the valleys being each distinctive and well wooded. The near neighbourhood is full of historic and archæological interest. Sherwood Forest is on one side and Little John's grave on the other. The Peak caverns, the beautiful Derwent valley, with Chatsworth and Haddon and the gorge of Matlock, are close at hand, and the whole district is a pedestrian's paradise. It is hoped no member of the association will be deterred from coming by what he has seen from the railways, which in many cases actually pass through some of the large works.

PROF. ROBERT KOCH, For.Mem.R.S.

By the death of Prof. Robert Koch there goes from amongst us one of the most remarkable men of his time, a man of tremendous determination, great capacity, and indefatigable energy, who has left an impress on the science and practice of medicine such as is made by a few exceptional men only. It would be affectation to say that all his work is of equal value, for although under his hand and mind no subject could remain unaltered, his pioneer work on the isolation and cultivation of bacteria in solid media, his studies in anthrax, and his work on tuberculosis and cholera, must always stand out above any other that he did. The controversial methods of his earlier years, as exemplified by his controversy with Pasteur in 1883, were succeeded by methods of a less pungent, but equally vigorous, character, but his arguments were always respected, even by those who did not agree with him, as those of a man thoroughly in earnest, whilst his utterances could always be accepted as those of a man who had every right, by reason both of experiment and experience, to give full and free expression to his opinions, opinions that must be carefully weighed and considered, especially by those who differ most widely from him.

Born in Klausthal, Hanover, on December 11, 1843, Robert Koch was a member of a large family. His father held some official position in the Department of Mines and Forests. At nineteen Koch commenced his medical studies in the University of Göttingen, at which he worked for five years. After passing his State examination and taking his degree, he became assistant medical officer in the General Hospital in Hamburg. He then engaged in private practice, first at Langenhagen, near Hanover, moving thence to Rackwitz, where he remained until he went as a volunteer surgeon with the army in the Franco-Prussian war. In 1872 he again started private practice, this time in Wollstein, in Posen, where he commenced his investigations and studies on the isolation of pure cultures of bacilli, studies which led to the method of cultivation of bacteria on solidifying media, a method to the use of which we owe many of the most important advances made in the bacteriology of disease.

Up to Koch's time, Salomonsen's and Cohn's methods of isolating single bacteria were the only methods available. Salomonsen mixed a very small number of organisms with a large quantity of blood, and drew the mixture into a series of long, fine glass tubes; then as the organisms grew and used up the oxygen in the blood, little black points made their appearance along the course of the tube. Blood taken from the tube broken at one of these black points was often found to contain a pure culture of a single organism only. This method, of course, could not receive very general application, but as the blood might coagulate in the tube, the organisms could not move about at all readily until the clot was broken down or decomposed by the organisms themselves. Cohn's method consisted in diluting the culture containing the organisms with very large quantities of broth, and then taking a single drop and transferring it to a flask or tube containing broth; in this case the observer trusted to the dilution being so great that a single drop would contain only a single organism. These methods, imperfect as they were, were used by Pasteur and Lister in their investigations, and were brought by them to considerable efficiency.

Koch's method of isolation was exceedingly ingenious but very simple. Taking a nutrient medium containing meat juice or sugar along with certain saline constituents to which had been added from 5 per cent. to 10 per cent. of gelatin, he boiled or heated the mixture several times to 70° C. or 80° C. in order to destroy any germs that might already be present. The material to be investigated was then added to this sterilised nutrient medium whilst still in a fluid condition. The mixture was then well shaken, so as to distribute any organisms that might be present, and poured over a glass plate sterilised by heat contained within glass vessels similarly sterilised. When this nutrient medium cooled down it became a solid jelly and the organisms were fixed in position, each organism giving rise to a colony, so that each organism with its progeny was isolated and could be studied separately. At this date we are apt to lose sight of how much bacteriologists owe to Robert Koch for this simple method, which was devised by him in order that he might study more thoroughly than had yet been done the anthrax bacillus, the bacillus that gives rise to splenic apoplexy in cattle, and to one form of malignant pustule in the human being. By means of this method, too, he was able to isolate and study various organisms found in wound infection and in septicæmias of certain animals, the results of which are given in a paper translated and published in 1880 in the Transactions of the New Sydenham Society. His studies on the production of immunity against anthrax in cattle and sheep were, however, anticipated by Pasteur, who, in 1881, gave his marvellous and striking demonstration at Chartres.

In 1880 Koch was appointed Government adviser to the Imperial Board of Health, and in the laboratories in the Louisenstrasse carried out that series of investigations which ended in the demonstration of the presence of the tubercle bacillus in the diseased tissues of tuberculous animals and in the sputum and tissues of human beings suffering from tuberculosis. Here again his ingenuity and mastery of methods enabled him to do what so many others had failed to accomplish—to stain the tubercle bacillus in the tissues and to isolate and study this organism on artificial media outside the body. As the tubercle

bacillus would grow luxuriantly only at the body temperature, Koch found it necessary to obtain some solid medium that would not melt at that temperature, and, going on the principle that the fluids of the body would probably afford the best nutrient medium for an organism that grows so readily in the tissues, he took the blood serum of sheep, calves, &c., which not only contained the necessary nutrient elements for the bacillus, but was consolidated by heat, and he found that if the consolidation were effected at a sufficiently low temperature, the medium retained most of its nutrient properties. Here again was a tremendous advance, and his paper, read on March 24, 1882, before the Berlin Physiological Society, and published in the report of the Imperial Board of Health, was received with acclamation on every hand, and although criticism of all kinds was directed against his findings, Koch maintained his thesis against all comers. After this work on tuberculosis, Koch was naturally looked to, not only by his own countrymen, but by scientific men of all countries, as the man most likely to solve the questions bound up in the causation of cholera. In 1883 he went out to Egypt on a quest for the *causa causans* of cholera, and in 1884 acted as chairman of the German Cholera Commission, which carried out much of its work in India. His works on cholera, one volume published in 1884 and a second in 1894, must be looked upon as classical monographs, and from 1884 onwards the cholera vibrio, or comma bacillus, became indissolubly associated with cholera as its prime etiological factor.

In 1885 Koch was appointed professor of hygiene in the faculty of medicine in Berlin University, and his classroom and laboratory became the resort of students from all parts of the world, as they had already been at the Gesundheitsamte, though on a smaller scale. His pupils there trained took up many of the problems for the consideration of which he had neither time nor energy. In 1890, at the tenth International Medical Congress, he announced the discovery of tuberculin, and, in a series of admirable experiments, demonstrated the action of tuberculin as an immunising agent, an aid to diagnosis, and even as a curative when injected into animals already suffering from tuberculosis. The announcement of this treatment seemed to give hope of prolonged life to thousands of tuberculous patients, many of whom clamoured to be treated. The method, however, had not been sufficiently fully developed, and there can be little doubt that it fell into disrepute, not because it failed to accomplish what had been claimed for it by Koch, but because it failed to give such results as had taken form in the imagination, alike of patients and of medical men, who could not understand the limitations of such a method of treatment—a method still in its infancy. Those, however, who really studied the tuberculin treatment never lost heart, and in 1897 Koch reported a new tuberculin, with which much more satisfactory curative results have since been obtained. There can be little doubt that some modification of this method must form the basis of any specific curative treatment.

In 1891 Koch was appointed director of the magnificent new Institute for the Study and Treatment of Infective Diseases, and here, with his band of workers, in which were men whose reputation is now world-wide, continued to work out some of the problems in which he was now interested. In 1896 he was called to South Africa to study rinderpest, a disease which, with the assistance of Kolle and Turner, he traced to its cause and for which he devised a method of immunisation. As the result of these observations, on which were built up investigations by later workers, rinderpest has become a manageable disease. At this time Koch first took up the question of sleeping sickness, but, like most other observers, he failed at the outset to find any organism that he could associate causally with the disease. From this he turned his attention to the bubonic plague, studying it in India and German East Africa. Following up the observations of Yersin and Lowson, and tracking down the bacillus of plague, he found that it was really conveyed by rats, and that, however, it was endemic in Mesopotamia, in Hunan in China, in Tibet and Mecca, and in Kissiba, Victoria Nyanza. As a result of his observations, he expressed the hope and assurance that in time these plague centres might be cleansed, and when the reservoirs and carriers of the disease could be localised, plague might gradually be exterminated. How far these prognostications may be realised it is still early to state, but the continuation of this line of research and the tracking down of the flea as a further carrier have undoubtedly brought this period nearer.

In 1901 Koch exploded his great bombshell at the International Congress on Tuberculosis in London when he said, "I feel justified in maintaining that human tuberculosis differs from bovine and cannot be transmitted to cattle." That he wished further evidence, however, is evident from the fact that to this statement succeeds the following:—"It seems to me very desirable, however, that these experiments should be repeated elsewhere in order that all doubts as to the correctness of my assertions may be removed." As regards infection of the human subject by the material from tuberculous cattle, he said:—"I should estimate the extent of infection by the milk and flesh of tuberculous cattle and the butter made of their milk as hardly greater than that of hereditary transmission, and I therefore do not deem it advisable to take any measures against it." It was this last statement to which special objection was made, as it involved such a complete alteration in our method of procedure in connection with milk and milk products from tuberculous cattle. It is not necessary here to repeat what has been now before the public for so long in the Interim Reports of the Royal Commission on Tuberculosis and of the German Commission on Tuberculosis, the Transactions of the International Congress on Tuberculosis at Washington, and many papers by individual workers. Moreover, there seems some reason to believe that latterly Koch had modified his views somewhat, in so far that in his interview with the *Times* correspondent in Berlin during the early part of last year he stated that the "Differences still unsolved between my critics in the Royal Commission and myself have been greatly reduced by further examination, and are now very slight." As shortly before his death Koch was making a very thorough search for the bacillus of bovine origin in cases of pulmonary tuberculosis, it is to be hoped that his colleagues and literary executors will give the world the results of his investigations.

In 1903, still in search of fresh fields to conquer, he returned to South Africa to study on the spot coast fever (allied to Texas fever), a condition due, apparently, to the presence of protozoal parasites in the blood. At this period his investigations were occupying so much of his time that in order to devote himself to them more thoroughly he retired from his position as director of the Institute for the Study and Treatment of Infectious Diseases. In 1905 he was awarded the Nobel prize in recognition of his great services to medicine, an award approved by all.

In 1906, returning to East Africa, he continued his studies on sleeping sickness, especially in relation to its treatment by atoxyl. At one time it appeared as though he had obtained a drug specific for this

disease. It was found, however, that although there was amelioration in the condition of the patient in the early stages of the treatment, the drug soon lost its effect, whilst certain sequelæ, *e.g.* blindness, the results of the action of the drug, led men to be exceedingly chary of using it. In connection with sleeping sickness, Koch, following up Bruce's theory of a living reservoir in which certain parasites might exist without giving rise to any definite and appreciable disease, instancing the wild buffalo, where the parasite is kept alive in its host without apparently doing any damage, but ready to attack non-immunised animals when carried to them by the tsetse fly (*Glossina morsitans*), Koch suggested that the crocodile might be the reservoir host of the trypanosome that gives rise, when carried to the human being by another tsetse fly (*Glossina palpalis*), to sleeping sickness, and he then made the suggestion, afterwards carried out, that the infective zone around certain waters should be cleared of its underwood, and the crocodiles lurking there and in the neighbouring waters killed. Koch also worked at malaria in Java and in the Malay Peninsula. He studied blackwater fever and tried to determine its relation to malaria, or, alternatively, to quinine poisoning contracted during the treatment of malaria.

Koch's last great public appearance was at the Washington Congress on Tuberculosis in 1908, when he announced that he intended to devote the remaining years of his life to the settling of the question that he had raised in London eight years earlier, and everyone hoped that he had some years of useful work before him. These years have been all too few, and we cannot expect that the work he then undertook is finished.

The record of a man's work is his best obituary notice—and in such a case as that now under consideration the writer is relieved of an enormous responsibility—but this notice would be very incomplete did it not contain some record of the honours accorded to him by his fellows, especially those who followed and appreciated his work. Robert Koch was an honorary member of a very large number of learned associations, amongst them of the Prussian Academy and of the Royal Society of London. He had been invested with the Prussian and French Orders of Merit, and with orders of various kinds awarded by the rulers of almost every State in Europe. In some cases these distinctions might mean but little to those who come after us, but, associated with Koch's name, they must ever retain their significance as associated with one of the names on the imperishable roll of the great in science. The death of Robert Koch involves a loss not to Germany only—all mankind is the poorer.

MAJOR PHILIP CARDEW, R.E.

MAJOR PHILIP CARDEW, whose death we record with deep regret, combined a fine mathematical mind with careful scientific training, and a remarkable natural ability in grasping the principles involved in any practical question. He passed through Woolwich Academy with every honour, and started a brilliant career in the Royal Engineers in 1871. He was appointed, in 1883, instructor in electricity at the Military School of Engineering at Chatham, and threw himself with great energy into those innumerable electrical problems which were being so rapidly developed in telegraphy, telephony, electric lighting and power. In 1888 he was selected as the first electrical adviser to the Board of Trade, and he inaugurated the rules and regulations for the use of electricity for public supply and for electric tramways and railways. These rules have formed a model for all countries, and there is very little doubt that the freedom of water and gas pipes in England from electrolysis due to stray tramway currents is the result of the wise restrictions which Major Cardew initiated. The standardisation of electrical units was part of his work.

When Major Cardew retired from the Board of Trade his energies were diverted into the execution of various lighting, power, and traction schemes. Under his personal guidance, every Government dockyard in the British Empire has been equipped with electric power, and numerous electric railways, tramways, and lighting systems originated. He was a prolific inventor. and his vibrator is largely in use in connection with military telegraphs, while the hot-wire voltmeter which bears his name was for years one of the few trustworthy electrical instruments. The Cardew safety earthing device has also been of great value in connection with the public supply of electricity.

Major Cardew contributed a number of papers on electrical subjects to the Royal Society and the Institution of Electrical Engineers.

His death, at the early age of fifty-eight, is greatly to be regretted. He was intimately associated with all the modern developments of electricity, and his experience and advice were much in demand.

NOTES.

IN consequence of the death of King Edward VII., the usual ladies' conversazione of the Royal Society will not be held this year.

AT a meeting of the council of the Royal Society, held on Thursday, May 26, at Burlington House, an address of condolence and homage to His Majesty King George V. was adopted, and the society's seal affixed. At the ordinary meeting of the society, which followed, the address was communicated to the fellows present by the president, Sir Archibald Geikie, who spoke as follows:—"Since the last meeting of the society a great calamity has unexpectedly befallen the country, and under the shadow of that mournful event we now resume our duties. The death of King Edward is a national loss, the full effect and meaning of which cannot yet be appreciated. We, fellows of the Royal Society, share in the universal sorrow that a life so revered, so full of achievement, and with the promise of still many fruitful years, should have been cut short in its prime. But we have also a more personal ground for regret. The late King had been for nearly half a century one of our fellows, and on his accession to the throne had become our patron. Among the many claims which His Majesty had to our regard, not the least was the interest which he always took in the furtherance of that natural knowledge which the Royal Society was founded by Charles II. to promote. In our annals the name of King Edward VII. will always hold an honoured place. The council has approved and sealed an address to His Majesty King George V. in which, while expressing our condolence in the deep grief of the Royal Family, we offer our respectful congratulations on his accession to the throne of his ancestors, and our confident hope that his reign may be long and prosperous." The address was then read from the chair, and was adopted in silence, the fellows present all standing.

As we go to press, the *Terra Nova* is starting on her journey with the British Antarctic Expedition, and, after calling at a number of places, is expected to arrive at Lyttelton, New Zealand, about October 13. Hitherto Antarctic expeditions have sailed to the south in the latter

part of December, but with the *Terra Nova* it is hoped to penetrate the pack ice at an earlier date than it has been possible for previous expeditions to do, and accordingly the ship will leave New Zealand towards the end of November, and probably reach McMurdo Sound about the end of December. On arrival in McMurdo Sound the western party will be landed, and as soon as the winter station has been established the greater number of the party will proceed to the south to lay depôts. It may be possible to start this party off not later than the third week in January. At the same time, the ship will leave McMurdo Sound and proceed to the eastward to explore King Edward's Land. A small eastern party will probably be left with full supplies and some transport facilities. After landing the eastern party the ship will return to McMurdo Sound, and then proceed to the northward. At the latest this will probably be in the third week of February. If there is coal enough the *Terra Nova* will be directed to investigate the pack in the region of the Balleny Islands, and to proceed to the westward or to the south of these islands. These objects will occupy the ship during the month of March, after which she will be directed to return to New Zealand. The western party, it is hoped, will by the month of April be safely established in the hut, with suitable depôts laid well south of the barrier. During the winter, preparations will be made for an effort to reach the South Pole in the following season. Captain Scott states that he does not propose to start upon the southern journey until the month of October. That month and the following will be spent traversing the Barrier and ascending the glacier. He hopes to reach the upper plateau fairly early in December, and an ideal day for reaching the South Pole would be December 22. Captain Scott will be accompanied by, among others, Lieut. E. R. G. R. Evans, R.N., second in command; Dr. E. A. Wilson, chief of scientific staff; Lieut. H. L. L. Pennell, R.N., magnetic and meteorological work in *Terra Nova*; Surgeon G. M. Levick, R.N., doctor and zoologist; Surgeon E. L. Atkinson, R.N., doctor, bacteriologist, parasitologist; Dr. G. L. Simpson, physicist; Mr. T. Griffith Taylor, geologist; Mr. E. W. Nelson, biologist; Mr. D. G. Lillie, biologist; Mr. W. G. Thompson, geologist; and Mr. C. S. Wright, chemist.

SIR DAVID GILL, K.C.B., F.R.S., has been appointed a Knight of the Prussian Order of Merit. The honour was conferred on Tuesday through the German Ambassador in London, by order of the German Emperor.

DR. W. THOMAS, assistant lecturer in the Liverpool School of Tropical Medicine, has been appointed director of the new laboratories at Manaos, in the State of Amazonas.

THE death is announced, in his sixty-third year, of Prof. W. Rose, emeritus professor of surgery at King's College, London, and author of a number of works on various surgical subjects, including the standard text-book "A Manual of Surgery," of which he was joint author with Mr. A. Carless.

THE Harben lectures will be delivered by Sir W. B. Leishman, F.R.S., professor of pathology in the Royal Army Medical College, London, in the Royal Institute of Public Health, on June 8, 15, and 22, the subject being "Anti-typhoid Inoculation."

THE *Pourquoi Pas?* having on board Dr. Charcot and other members of his expedition to south polar regions, arrived at Guernsey on Tuesday. Dr. Charcot expressed satisfaction with the journey, and said that he had accomplished all that he had expected, and had brought back valuable scientific results, including a large collection of animal remains. Among the geographical results is the charting of land south of the Adelaide Islands.

THE council of the Royal Society of Arts has elected the Hon. Theodore Roosevelt a life member of the society under the terms of the by-law which empowers it to elect annually not more than five persons who have distinguished themselves by the promotion of the society's objects. The first American member of the society was Benjamin Franklin, who was elected in 1755.

THE annual general meeting of the Research Defence Society will be held on Friday, June 3, at 5 o'clock, in the library of the Royal College of Physicians, Pall Mall East, S.W. The chair will be taken by the Earl of Cromer, president of the society. The other speakers will be Sir Richard Douglas Powell, Bart., K.C.V.O., Sir David Bruce, K.C.B., F.R.S., Mr. Anthony Hope Hawkins, and Mrs. Scharlieb.

THE *Times* Geneva correspondent reported that on May 26, at 7.12 a.m., a violent earthquake shock traversed the whole of Switzerland from north to south, touching Bâle, Zürich, Berne, and Geneva. Messages from Paris and Berlin showed that the shock was felt at Belfort, Mühlhausen, Upper Alsace, and parts of Baden. At Freiburg the shock lasted for some seconds. During the previous evening violent thunderstorms visited some parts where the earthquake was recorded.

THE annual meeting of the Selborne Society will be held in the theatre of the Civil Service Commission, Burlington Gardens, on Friday, June 17. After business has been transacted an address will be delivered by Mr. J. Buckland on the traffic in feathers and the need for legislation. The Selborne Society, of which the late Lord Tennyson was, and Lord Avebury now is, president, has recently been developing its work and increasing its activities. During last year it acquired new offices at 42 Bloomsbury Square, in order to form a home for its library and to provide reading and committee rooms.

THE council of the Institute of Metals has appointed a committee to investigate the causes of the corrosion of non-ferrous metals by sea-water, acids, &c., and by other chemical and electrolytic reactions. The members of the committee are:—Sir Gerard Muntz, Bart. (chairman), Prof. H. C. H. Carpenter (secretary), Captain G. G. Goodwin, R.N., Prof. A. K. Huntington, Mr. J. T. Milton, Mr. A. Philip, Mr. L. Sumner, Prof. T. Turner, and Sir William H. White, K.C.B., F.R.S. The committee has decided, in the first instance, to confine its attention to the question of the corrosion of condenser tubes in marine engines and in stationary engines using foul water, or being subject to violent electrolytic action, such as often occur in electric power stations.

MANY members of the British Association will learn with regret of the death of Mr. Alfred Colson, who was chairman of the executive committee and local honorary secretary for the meeting of the association at Leicester in 1907. Mr. Colson was a past-president of the Institution of Gas Engineers, and also of the Leicester Literary and Philosophical Society. His work as the gas and electric light engineer of the Leicester Corporation will remain a permanent memorial to his adaptability and technical knowledge, and his great organising powers will be remembered by all who were present at the Leicester meeting of the British Association.

The Board of Education has been informed through the Foreign Office that the second session of the seventeenth International Congress of Americanists will be held at Mexico City on September 8–14. The sessions will be held in the lecture hall of the National Museum in Mexico City. An organising committee has been formed, the president of which is Sr. Lic. D. Justo Sierra, Secretary of Public Instruction and Fine Arts for the Government of Mexico. Communications to the congress, which may be either oral or written, may be made in English, French, German, Italian, Portuguese, or Spanish. The congress will deal with questions relating to the ethnology, archæology, and history of the New World. For further information application should be made to the general secretary of the organising committee, Sr. Lic. D. Genaro Garcia, Museo Nacional, Mexico, D.F.

We regret to see the announcement that Prof. Emil Zuckerkandl died on May 28, in his sixty-first year, at Vienna, where he had occupied the chair of anatomy for nearly thirty years. He was well known to anatomists for his many and varied contributions to human and mammalian morphology. He was trained under Hyrtl and Carl Langer, and acted as prosector in the University of Vienna until he was called to fill the chair of anatomy at Gratz in 1887. His best known work, on the anatomy and diseases of the nasal cavities (1882–92), is one which will remain an authoritative memoir for many years to come. His numerous monographs on the arterial system and on the morphology of the brain, especially of the ape and marsupial, are based on elaborate and patient observation, but somewhat prolix, and unrelieved by wide and happy generalisations. It is rather his contributions to the more medical and practical side of human anatomy that will prove of permanent value. He was successful in maintaining the world-wide reputation which Hyrtl and Langer and other previous occupants of his chair had won for the Anatomical School of Vienna.

Mr. Michael Carteighe, whose death occurred at Goring-on-Thames on May 30, was for fourteen years president of the Pharmaceutical Society of Great Britain. He received his pharmaceutical education at the School of Pharmacy, and also studied at University College, London, where he became demonstrator in chemistry under Prof. Williamson. While at University College he took part in some important chemical and physical researches, one of the most notable being an investigation of the electrical conductivity of alloys, wherein he was associated with Drs. Matthiessen and Holzmann; the results of the work were embodied in a paper which was read before the Royal Society. Circumstances decided him not to pursue a scientific career, and he joined his brother, who was a partner in the pharmaceutical business of Messrs. Dinneford and Co., and on the death of his brother he became sole proprietor. He first became a member of the council of the Pharmaceutical Society in 1866, and assisted in the drafting of the Pharmacy Act of 1868, by which the sale of poisons was restricted to registered chemists and druggists, and the practice of pharmacy placed on a more or less regular basis. For many years he was a member of the society's board of examiners. From 1882 to 1896 he held the office of president, and his endeavour throughout that period was to place the educational standard of pharmacists on a higher plane, for he realised the force and wisdom of the policy of the founders of the society, namely, that the foundation of effective organisation was education in its widest sense; his efforts were largely devoted to securing for the society a position among the recognised technical and scientific institutions of the country. With his period of office are associated radical improvements in the society's school, the development of the library and museum, and the foundation of the research laboratory. Notwithstanding the amount of time he devoted to the Pharmaceutical Society, Mr. Carteighe found opportunities for work in other directions; he was one of the founders of the Institute of Chemistry, of which he was for many years a vice-president. He was also a vice-president of the Society of Arts during several years, was one of the most prominent members of the British Pharmaceutical Conference, and was for forty years a member of the Royal Institution. Mr. Carteighe was in his sixty-ninth year.

A description of the Mitsu-Bishi Dockyard and Engine Works appears in *Engineering* for May 20. These works are among the oldest and largest in Japan, and are situated at Nagasaki and at Kobe. The completeness of the equipment will be understood from the fact that the company is capable of producing, without subcontracting, not only every type of ship, machinery, and boilers for land and marine use, but also of steel girders, steel buildings, electrical machinery, Parsons marine steam turbines and turbo-generators, Stone's manganese-bronze castings, and Morison's "Contraflo" condensers. The company is one of the most important exhibitors at the Japan-British Exhibition at Shepherd's Bush. It is of interest to note that, both in the Nagasaki and Kobe works, the specification and wording in drawings, books, forms, orders, &c., in fact, every writing in the establishment, are in English, besides a greater portion of the correspondence. It is curious to notice a workman carrying out the work to the letter with a drawing worded entirely in English, although he is not able to quote a simple intelligible sentence.

In a paper on steel testing read at the Institution of Mechanical Engineers on Friday, May 27, by Mr. B. Blount, Mr. W. G. Kirkaldy, and Captain H. Riall Sankey, comparisons are made of the tensile, impact-tensile, and repeated bending methods of testing. In the impact-tensile method the specimens were not notched, as is more usual in other impact tests, and were attached to a tup arranged to fall freely through a height of 30 to 40 feet. The tup was of adjustable weight, and was attached to the lower end of the specimen, a cross-head being fixed to its upper end. After falling a measured height the cross-head is arrested by coming into contact with the top faces of a split anvil; the specimen is broken, and the tup continues its fall between the two parts of the anvil. The breaking of electrical contacts during the fall enables the energies at impact and after impact to be deduced, and hence the energy utilised in breaking the specimen. In this method the whole of the material in the cross-section under observation is brought simultaneously under the influence of the impact stress. Three test-pieces of each type of steel were broken by this method, and the readings agree fairly well as regards the energy absorbed by the rupture. The average disparity from the mean is about 6 per cent. The readings of elongation and contraction of area are also in good agreement.

The old myth of the occurrence of live frogs and toads enclosed in blocks of stone or of coal is not yet dead, but ever and again shows signs of life in the way of vigorous assertion of supposed cases of the phenomenon. We have received a communication from a resident in Leicestershire in which the writer states that, while recently breaking a lump of coal, "from the centre a live half-grown toad fell

out on its back. I called the attention of my neighbours to it, and I thought it was dead; but in a few minutes it began to move about, so I took care of it, and have it now as well as the piece of coal. There is the cavity in the coal where it laid. I can vouch for its genuineness. Is it of any value as a curio to naturalists or geologists? I have had several amateurs to see it" It matters little to tell the reporters of such occurrences that the thing is absolutely impossible, and that our believing it would involve the conclusion that the whole science of geology (not to speak of biology also) is a mass of nonsense. Why that is so it would be difficult to make them understand, for at present, with the exception of the comparatively few professional and amateur geologists, the general public, even some of the most educated, are as ignorant of the most elementary facts of geology as they are of the Chinese language. All popular beliefs, however, rest upon some basis of fact, though the facts may be imperfectly observed and erroneously interpreted. The true interpretation of these alleged occurrences appears to be simply this—a frog or toad is hopping about while a stone is being broken, and the non-scientific observer immediately rushes to the conclusion that he has seen the creature dropping out of the stone itself. One thing is certainly remarkable, that although numbers of field geologists and collectors of specimens of rocks, fossils, and minerals are hammering away all over the world, not one of these investigators has ever come upon a specimen of a live frog or toad imbedded in stone or in coal. Why are these alleged occurrences testified to only by those having no knowledge of geology, and, indeed, for the most part by uneducated workmen? It would indeed be an epoch-making event in the history of science if, for instance, a member of the Geological Survey should lay before us a genuine case of a live frog enclosed in stone!

To the May number of the *Psychological Review* Miss June E. Downey contributes a paper on the determination of sex from handwriting. She concludes from her investigations "that it is possible to determine sex from handwriting in perhaps eighty cases out of a hundred." She finds that "the presence or absence of the so-called sex-signs is . . . influenced largely (1) by the amount of writing done; (2) by age and consequently, to a certain extent, by practice; (3) by professional requirements such as shown by the conventional writing of grade teachers and the rapid hand of bookkeepers." The writing of two hundred persons was examined in this investigation, being submitted to "two professional graphologists and to fifteen persons ignorant of the art of graphology. . . ." A considerable number of the two hundred persons whose writing appears in the series are known to have been educated wholly in co-educational schools in America.

MR. G. W. LAMPLUGH, F.R.S., sends us an interesting article (reprinted from the *Naturalist*) entitled "Man as an Instrument of Research," which formed his recent presidential address to the Hertfordshire Natural History Society. We quote the following paragraphs:—" . . . first, to learn rightly to understand the evidence of the senses; and next, to learn to convey what has been gathered from them in unmistakable terms, are the indispensable qualities in the equipment of man as an instrument of research. . . . Unless . . . we qualify not only as observing, but also as recording instruments, the new knowledge we may have acquired remains merely personal. . . . I suppose that one of the chief difficulties experienced by everyone using language for the description of phenomena is that the observed facts form, as it were, an entangled mass, with innumerable threads, interlacing, converging, diverging around their common centre in all directions; whereas their expression in language necessitates that the corresponding ideas shall be spun off in linear sequence on a single plane."

IN a paper recently read before the Royal Philosophical Society of Glasgow, Prof. G. Elliot Smith discusses the evolution of the practice of mummification in Egypt. It originated from the experience gained of the desiccation of the corpse in hot dry sand. The activity of the grave-plunderer even in pre-dynastic times necessitated adoption of precautions to secure the safety of the remains, and the discovery of the use of copper led to the invention of the coffin, the sarcophagus, and the rock-cut tomb. The abundance of salt and soda, and the use of resin by women for cosmetics, suggested the custom of embalming. The difficulty of accepting this explanation has hitherto lain in the late date assigned to most existing mummies, none of those in the Cairo Museum being older than the last king of the seventeenth dynasty (*circa* B.C. 1580); but much older mummies have recently been traced. One of the time of Snefru was found by Prof. Flinders Petrie near the Medum Pyramid in 1891, and was examined by Prof. Keith (NATURE, 1908, p. 342). The date of this specimen has now been fixed by Dr. G. A. Reisner about 2700 B.C. (NATURE, March 31, p. 136). It is thus more than eleven centuries older than the other examples, and justifies the belief in the early adoption of the practice of mummification in Egypt.

THE *Zoologist* for May is largely devoted to the habits of animals, Mr. B. F. Cummings contributing the first portion of an article on the formation of useless habits in British newts, as observed in specimens in captivity, and Mr. E. Selous continuing his observations on the nuptial habits of the blackcock.

DR. W. E. HOYLE has sent us a copy of a list of the generic names of the dibranchiate cephalopods, with their typical species, published in vol. xxxii. of the *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, forming the "Festschrift zum Siebenzigsten Geburtstag von Wilhelm Kobelt."

To vol. xxxii., Nos. 2 and 3, of *Notes from the Leyden Museum*, Dr. E. D. Van Oort contributes a long list of birds from western Java and Krakatau, among which a Gerygone is described as new. Later on Dr. E. Hartert expresses the opinion that Passerina, in place of Plectophenax, should be used as the generic title of the snow-buntings, while Dr. Van Oort maintains precisely the opposite. This scarcely looks like the attainment of that uniformity in nomenclature of which so much is from time to time heard.

ACCORDING to the *Field* of May 21, a correspondent of the *Baltische Waidmannsblad* states that before the Russians came to the province of Ussuri the tiger was literally king of the forest in that district. The natives, Chinese and others, as well as the immigrant Coreans, looked upon the animal as a god. If any of them met a tiger there was no question of resistance or fighting; the man threw himself on his knees and allowed himself to be killed if the animal attacked him. When domestic animals were seized, the owner looked quietly on. Generally it was the Chinese who risked their lives when they went to the forest to collect shed deer antlers or roots of the gusing plant for medicinal purposes. They fell easy victims to the tigers, which at that time frequented the immediate neighbourhood of Vladivostok, where the primeval forest remained dense and almost impenetrable. Gradually the Russians settled in these tracts, and the first thing they

did was to clear away the trees in order to cultivate the land. This checked the tigers, and not only did the white man defend himself with courage when attacked, but became the aggressor. The tigers came to distinguish between Chinese and Coreans on the one hand and white men on the other, and, unless circumstances prevented, avoided the latter.

A USEFUL "Catalogue of Nearctic Spiders," by Mr. Nathan Banks, has lately been issued as Bulletin 72 of the United States National Museum. It includes more than 1300 species, and the author anticipates that at least 2000 will be recognised "when the west and south are explored as thoroughly as New England now is." The arrangement followed is on the whole that of Simon's "Histoire naturelle des Araignées." It is of interest to note that a large proportion of genera and a small proportion of species are common to the European and North American faunas. The inclusion of the southern States in the "Nearctic Region" leads to the appearance of some characteristically tropical spiders, such as the large Theraphosidæ, but there is no information as to the distribution of northern species in Canada.

OF the various agricultural students' publications, few are more interesting than the Proceedings of Armstrong College Agricultural Students' Association. The current issue (part ii., vol. ii.) contains a paper by Dr. Stevenson on Aberdeen Angus cattle, their breeding and management, and a very readable essay by Mr. Walling on a typical north Devonshire farm. The association encourages its members by the offer of prizes to prepare papers on agricultural subjects, and to carry out agricultural experiments. The membership during the past year is stated to have been 130.

THE prospects of vanilla-growing in the West Indies are discussed in a recent issue (No. 204) of the *Agricultural News*, the problem having arisen because of the recent rise in price of vanilla. Hitherto there has been some fear, not altogether unfounded, that the synthetically prepared vanillin would drive the natural product out of cultivation, but since the passage of the American pure-food law has necessitated a declaration of the materials used, it has been found that people prefer the natural vanilla, the sale of which is said to have increased in consequence. It appears that the general production and consumption are both increasing, but only in the French colonies is there any immediate likelihood of over-production. The reports from various markets which are summarised in the article seem to be favourable on the whole.

MR. J. W. SMALL has recorded in the *Ceylon Observer* the occurrence of a cocoa-nut palm at Jaffna, Ceylon, with sixteen branches arising near the base of the plant. A similar instance, but with only five branches, is described by Dr. S. Pulney Andy in the Transactions of the Linnean Society, Botany, xxvi., 661. A list of branched specimens of Cocos is given by Morris in the Journ. Linn. Soc., xxiv., 1892, 294, in a paper on the occurrence of branching and forking in palms. Ridley, in the *Annals of Botany*, xxi., 45, and xxiii., 338, enumerates nineteen genera of palms in which branching of the stem takes place, and states that this occurs most commonly in *Cocos nucifera*, although the percentage of branched trees is not large. In most cases the branching appears to be due to the development of lateral buds, and the rapidly growing shoots so produced soon equal in size that from which they originated. It has been stated, though not clearly proved, that the destruction of the terminal bud by insect or other agency may be followed by the production of lateral buds. No instance of branching in monocarpic palms has been recorded.

A PAMPHLET on the origin of typhoons has been prepared by Mr. J. I. Plummer, chief assistant, Hong Kong Observatory. The author points out that although his paper has not received the imprimatur of scientific opinion, it is at least the outcome of twenty years' experience of typhoons, with exceptional means for their examination. Much still requires to be known about the tracks followed by such storms, the cause of their re-curvature, rate of translation, and frequency. They have been under special observation in the vicinities of Mauritius, Bay of Bengal, Eastern Archipelago, south-east of China, and West Indies. Their frequency varies considerably in these localities; in the Bay of Bengal and the West Indies the storms, the author states, appear to be more noted for their severity than for their number, while the northern part of the China Sea appears to be more troubled by them than any other portion of the globe. Among the main conclusions drawn are, (1) that although the open sea is the point where they become appreciable, the earliest beginnings of typhoons must be sought for on land; (2) that one typhoon is never the cause of another; if several proceed from a limited area within a few days, they are caused by separate impulses; (3) that a typhoon, once formed, does not tend to coalesce with another, but rather repels it, with the result that one becomes intensified at the expense of the other.

IN the second number of the Bulletin of the Calcutta Mathematical Society (1909), recently received, Prof. C. E. Cullis continues his discussion of Möbius's cubic surface, the nature of which was explained fully in the first number. In addition to several other original papers, a translation is given of the late Prof. H. Minkowski's address on space and time, and the notes, abstracts, and lists of current literature render this second number as valuable a book of reference to the mathematician as its predecessor.

AN interesting new "record" in connection with the possibilities of microscopic vision is mentioned in the Journal of the Royal Microscopical Society (April) by Mr. Edward M. Nelson. In 1898 Mr. Nelson observed, for the first time, tertiary markings on the diatom *Coscinodiscus asteromphalus* mounted in realgar in a slide of "Nottingham" deposit. Although he has tested hundreds of objectives with a balsam mount of the same diatom, it has been found impossible to resolve the tertiaries in this medium until a month or two ago, when a new Zeiss's long tube $\frac{1}{8}$ apochromatic of numerical aperture 1·4 rendered them conspicuous. A comparison of this test with the previous ones leads the author to assert that the new lens marks a distinct advance on its predecessors.

UNDER the title "The Most Curious Craft Afloat," Dr. L. A. Bauer gives in the March number of the *National Geographic Magazine* (Washington) an interesting popular account of the work of the non-magnetic yacht *Carnegie*. The article is well illustrated from photographs taken by various expeditions sent out by the Carnegie Institution of Washington, and some of the illustrations enable one to appreciate very thoroughly the difficulties of magnetic survey work in the remote parts of Canada, India, and China.

SEPARATE copies have reached us of several papers which the staff of the Reichsanstalt at Charlottenburg have communicated to the "Annalen der Physik" during the last six

months. Amongst them are two which deal with the saturation pressure of water vapour at temperatures outside the range 50° C. to 200° C., covered by the experiments of Drs. Holborn and Henning in 1908. The first paper, by Drs. Scheel and Heuse, deals with temperatures between 0° C. and 50° C. They use the static method, measuring the temperature by a platinum thermometer and the pressure by the modified mercury manometer we noticed in these columns some time ago. The second paper, by Drs. Holborn and Baumann, deals with the range from 200° C. to 376° C. Temperatures were measured by the platinum thermometer, pressures by a weighted piston moving in a brass cylinder. Except at the highest temperature the three sets of measurements can be represented by formulæ of the type suggested by Thiesen,

$$i.e.\ (t+273)\log\frac{p}{760}=a(t-100)-b\{(365-t)^4-265^4\},$$

where a and b are constants.

MR. W. P. SEXTON informs us that the value of the specific heat of the first four molecules of water of crystallisation in copper sulphate given by him in his note to the Faraday Society, referred to in NATURE of May 5 (p. 292), should have been 0·449, and not 0·499, as stated in our report.

THE issue of *The Central* for April is a memorial number dealing with the life and work of the late Prof. W. E. Ayrton, F.R.S. The number contains two memoirs by Mr. Maurice Solomon and Prof. T. Mather, F.R.S., respectively, and is illustrated by four portraits of Prof. Ayrton at various ages. A list of Prof. Ayrton's scientific publications completes the number.

THE first parts of two new works dealing, respectively, with "Our Canaries" and "Cage-bird Hybrids," have been received from the office of *Cage Birds*. The works will be published in monthly parts, price sixpence each, and will provide keepers of canaries and breeders of canary mules and British bird hybrids with full details relating to the selection, breeding, and general management of these cage birds, either for pleasure or profit. Coloured plates and other illustrations add to the attractiveness of each work.

THE Sleeping Sickness Bureau, under the direction of its honorary managing committee, has issued a revised edition of its brochure entitled "Sleeping Sickness: How to avoid Infection." The pamphlet is for the use of travellers and residents in tropical Africa, and gives an account of *Glossina palpalis* and illustrations of this and other biting flies. Much useful information is provided as to places where persons are liable to be bitten, and the steps to be taken to abolish and to prevent the spread of the fly.

A COPY of the report of the Indian Association for the Cultivation of Science for the year 1908, which was published in Calcutta last year, has just been received. One of the chief activities of the association is the arrangement of lectures on scientific subjects, and we notice that 286 were given under the auspices of the association during 1908. The association also conducts a chemical laboratory, where students are encouraged to follow systematic courses of work, and arranges for regular meteorological observations to be taken at its observatory and for their publication. The finances of the association appear to be in a flourishing condition. In fact, the officers may be congratulated upon the useful work which is being accomplished under their guidance.

OUR ASTRONOMICAL COLUMN.

THE SOLAR CONSTANT.—In No. 4, vol. xxxix., of the *Memorie della Società degli Spettroscopisti Italiani* Dr. Gorczynski discusses the pyrheliometric observations of the solar constant made at Ursynova (Polonia) during 1909. The value obtained was 2·05 gr. cal./cm.^{2} min., and, from a discussion of the values obtained at various observatories by different methods, Dr. Gorczynski concludes that this value is very near the truth.

ORIGIN OF BINARY STARS.—In No. 3, vol. xxxi., of the *Astrophysical Journal* Prof. H. N. Russell discusses the origin of binary stars from the point of view that they are produced by the fission of rotating masses. He deduces the conditions of such a mass which would precede and follow the process of fission, and also shows that the available data derivable from existing systems are in accordance with the theory. Finally, Dr. Russell concludes that whilst the development of nuclei in the original nebula must be invoked to account for the formation of star clusters, it is more reasonable to suppose that binary systems have been produced by fission.

THE ASTRONOMICAL SOCIETY OF ANTWERP.—The annual report, for 1909, of the Société d'Astronomie d'Anvers contains a record of much, extremely useful, service performed in the popularisation of astronomy. Popular lectures in French and Flemish were given by various members of the society, and were free to all; further, they were well attended. There is a project on foot to obtain facilities from the town authorities for the erection of a larger observatory, and it is expected that the object will be attained during the present year; the society could then do more than ever to spread the study of the heavens.

The interest in, and general ignorance concerning, Halley's comet displayed by English crowds during the past few weeks engender the wish that more could be done for popular astronomy in England, and the present moment seems favourable; but it could probably only be done by the private munificence of some friend of science. There can be no two opinions as to the urgent need for popular instruction in the oldest of the sciences.

OBSERVATIONS OF HALLEY'S COMET.

THERE is little more to record of Halley's comet yet; as a popular spectacle, in England, its appearance has been somewhat of a failure, and we shall have to wait some little time before the results obtained by astronomers in different countries are available. Some amount of resentment has been expressed in the popular Press at the feeble appearance of the famous comet, but it should be clearly understood that it is our hazy summer skies and the brightness of our northern twilight that are to blame. In a letter to Prof. Turner Mr. Knox Shaw, of the Helwan Observatory, describes it as really a glorious sight, about May 11, far exceeding in its glory comet 1910*a*; it then had a straight tail 38° long. Yet at Helwan there were only three fine nights during the first fortnight in May.

With his note in No. 20 of the *Comptes rendus* (May 17) M. Esclangon gives four diagrams showing the progressive development of the nucleus and its appendages between February 13 and May 11. On the former date the nebulous head was nearly circular, but the ill-defined nucleus had already two embryo extensions, which gave it a triangular appearance. On April 27 the head was parabolic, with the nucleus a little behind the focus, and two jets forming a broad **V** streaming behind; there was also a bunch of rays issuing in the shape of a fan towards the sun. On May 10 this aigrette was larger and better defined, having an angle of 70° and a length of about 30″, but the two rear streamers were not so definite. Up to this time the aigrette had appeared to be symmetrical with regard to the axis of the comet, but on May 11 it was appreciably displaced, the angle between the axes of the aigrette and of the comet being some 20° or 30°. M. Esclangon suggests that this observation might indicate an oscillation of the aigrettes such as was noted during the apparition of 1835. He also remarks upon the great length of tail, which on May 16 was about 65°, corresponding to an actual length of 0·20 astronomical unit.

The observations of M. Borrelly, recorded in the same number of the *Comptes rendus*, indicate what a splendid object the comet has appeared to those situated in a favourable atmosphere. "Very beautiful," "superb," and "magnificent" are the descriptions applied to it as seen at the Marseilles Observatory. The observations extended from April 16 to May 13, and many changes were noted; on April 23 it was seen that the nucleus had a very pronounced red tint. On May 4 the comet was as bright as Markab, and the tail was 15° long. A sudden transformation took place on May 13, when, for the first time, a bright, straight streamer was seen to issue from the rear of the nucleus, dividing, medially, the rectilinear tail, which then had a length of 43°; the extremity of this tail was about as bright as a sixth-magnitude star, and was situated, approximately, in the position R.A. 22h. 6m., dec. +6°; the comet was still visible in daylight.

In order to escape the disadvantageous conditions obtaining in Britain, Prof. George Forbes took a sea trip from Swansea to Savona, and was rewarded by some splendid views of the comet, which he describes in the *Times* for May 31. The observations commenced on May 15, and the head of the comet was never seen, but on May 18 a tail extending for 100° was watched from 2 a.m. until 5 a.m.; this was in long. 9° 38′ W., lat. 38° 54′ N. On May 15 the 30° tail was about as bright as the Milky Way, but the next morning it was fainter; at times, however, it appeared to brighten. The morning (3 a.m.) of May 17 found it again much brighter for fully 50°, and it could be distinctly traced for a distance of 70°. The tail was perfectly straight, and narrowed down towards the extremity furthest from the sun; across its width its brightness appeared to be quite homogeneous, there being no dark shade along the axis and no rifts. As compared with the tails of Donati's and Coggia's comets it was, so far as Prof. Forbes's memory goes, much brighter and of a much greater length. On May 18 the tail was much widened at the root, where the brightness appeared to be concentrated; the narrowing from root to tip appeared to be more accentuated, and the position of the axis among the stars had not altered from the previous day.

According to Prof. Forbes, the earth was in the tail of the comet on May 19, and, from 2.30 to 3 a.m., a brightening near the horizon and an illumination of the dark edges of dense, black, cumulus clouds were seen by him and by the ship's officers. This was long before any trace of dawn could appear, and all the observers agreed that these peculiar phenomena must be due to light from the comet's tail; the ship was then in long. 7° 54′ W., lat. 36° 36′ N. The same phenomena were repeated on the following morning. It should be noted that at the time of writing his notes (May 24) Prof. Forbes had not seen any reports concerning the cometary observations, since the S.S. *Kinsale* left Swansea on May 13.

In a letter received from Mr. G. W. Grabham, dated Khartoum, May 19, the writer remarks how feeble the accounts of British observations of the comet appear to one who has observed it in lat. 15° 36′ N. He first saw it on April 19, when it was a conspicuous object, with a tail broad in proportion to its length. With field-glasses he could make out some 2½° or 3° of tail, and beyond that there was a faint glow extending about 2° further. A letter sent by Mr. Grabham to the *Sudan Times* caused a number of people to wait up for the comet, and it was easily seen by many on subsequent mornings, until it became more difficult owing to bright moonlight. After the moon waned it was quite a striking object, and, on the mornings of May 12 and 13, its tail stretched halfway to the zenith. An article on the comet, written by Mr. Grabham, appears in the *Sudan Times* in both English and Arabic.

Mr. Leach also sends us a further report and a drawing of the comet as seen with field-glasses on May 20, at 7.45 p.m., at Malta. On May 17 and 18 the comet was well seen, except the head, which was eclipsed by a searchlight beam from the forts; but the tail was seen, and, on the latter date, extended to a distance of about 95°. The sketch made on May 20 shows the nucleus surrounded by a misty halo which has the shape of a pair of horns, with the nucleus on the forehead. On May 21 about 20° of tail was seen, but this faded as the moon got brighter, and on May 22, 23, and 24 the comet was seen without any signs of a tail.

A number of notes on the comet appear in No. 21 (May 25) of the *Comptes rendus*. M. Eginitis records the observations made at Athens on May 18 and subsequent days. On the morning of May 20 the tail was seen in exactly the same position as the previous night, and in the evening was seen, in the telescope, as turned towards the sun. On account of its curvature it was not seen in the east on Saturday morning (May 21), but in the evening was seen turned towards the east. M. Eginitis is of the opinion that the earth's passage through the tail was either greatly retarded or did not take place; nor were any signs of the head apparent as it transitted the sun's disc.

M. André reports that the preparations for astronomical observations of the passage were rendered nugatory by clouds, and that the electrometers and magnetometers recorded no abnormal action.

Acting upon M. Guillaume's suggestion, M. Georges Claude attempted to trace cometary matter among the residual inert gases left from the liquefaction of air. With his apparatus at Boulogne-sur-Seine he is able to treat 350,000 litres of air per hour, and to detect the presence of one-millionth part of any extraordinary gas. Experiments carried out on May 17 (4 hours), 19 (9h. to 12h., Paris M.T.), 20, and 23 failed to reveal any difference of density in the residue greater than the probable error of observation.

MM. Angot, Lebel, and Limb and Nanty, all report slight electric and magnetic disturbances registered at their observatories during the computed time of the earth's passage through the tail of the comet; but in no case was the disturbance extraordinary, nor could it be attributed to any abnormal condition produced by the comet.

Apparent path of Halley's Comet, May 29–July 16.

The following is a further extract from the daily ephemeris published by Dr. Ebell in No. 4411 of the *Astronomische Nachrichten*:—

Ephemeris for 12h. Berlin M.T.

Date	α (true) h. m.	δ (true) ° ′	Date	α (true) h. m.	δ (true) ° ′
June 2 ...	10 0·4 ...	+1 34·2	June 26 ...	10 43·0 ...	−2 20·1
,, 6 ...	10 13·7 ..	+0 23·1	,, 30 ...	10 46·7 ..	−2 41·8
,, 10 ...	10 22·6 ...	−0 25·4	July 4 ...	10 50·1 ...	−3 2·6
,, 14 ...	10 29·2 ...	−1 1·8	,, 8 ...	10 53·3 ...	−3 22·8
,, 18 ...	10 34·5 ...	1 31·5	,, 12 ...	10 56·4 ...	−3 42·8
,, 22 ...	10 39·0 ...	−1 57·0	,, 16 ...	10 59·5 ...	−4 2·9

The estimated magnitudes decrease from 1·0 on June 2 to 4·6 on July 16, while the distance from the earth increases from 52 to 197 millions of miles.

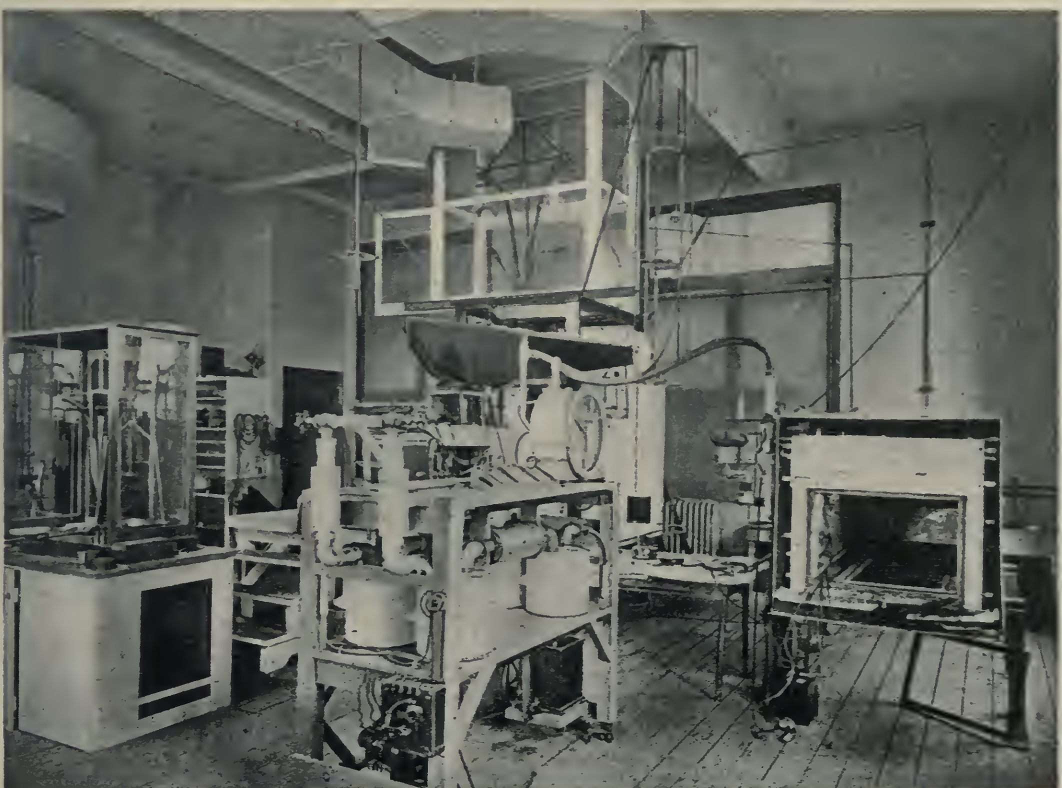
The apparent path among the stars is shown on the accompanying chart, but owing to its increasing apparent proximity to the sun and its decreasing magnitude the comet will be observed with difficulty during the later part of the ephemeris. The planets Mars and Jupiter are also shown, but Mars will set at about 10 p.m. on June 25 and about 2½ minutes earlier each succeeding day, whilst Jupiter sets at about midnight at the end of June.

A NUTRITION LABORATORY.

ATWATER'S development of apparatus for the exact measurement of the heat given off by the human body under varied conditions of food-supply and activity is well known. Prof. F. G. Benedict, who cooperated with Atwater, has continued similar observations as director of the Nutrition Laboratory in Boston, which is devoted exclusively to work of this type, and is well endowed by the Carnegie Institute for that purpose. The calorimeter equipment of this new laboratory, as described by Benedict and Carpenter in a recent publication,[1] affords remarkable evidence of the value that may be secured by giving a mature investigator a free hand in the organisation of means for furthering standard research of the type in which he is most interested.

Two "respiration calorimeters," shown in the accompanying photograph, have been constructed, and are in use for observations upon subjects of different physiques and different conditions of health continued over periods of several hours. Others are being constructed for more prolonged observations, occupying days, under varied conditions of rest and work. In their construction a rare amount of successful attention to minute detail has secured perfect instruments showing at every point substantial improvements upon the original pattern. As tested by the combustion of known quantities of ethyl alcohol within these chambers, the errors in estimating the amount of oxygen consumed, the carbonic acid and water vapour given off, and the output of heat, have been reduced to less than 0·5 per cent. The tests were made with the apparatus arranged as for an actual experiment, and the difficulties surmounted may be gathered from the fact that, through the "closed circuit" formed by the calorimeter chamber and a series of water and carbonic acid absorbers, 75 litres of air are driven per minute over periods of hours without leakage of material or of heat. The heat issuing from the subject is carried out of the chamber along one definite channel by a stream of water traversing a "radiator system" within the chamber, and is accurately measured by weighing the escaping water and observing its temperature increment. The ingenuity displayed in modifying known thermometric methods in the interests of these observations, and in obtaining continuous records of temperature differences, is in itself remarkable.

In the accompanying illustration are shown some of the internal fittings of the large constant temperature room in which the calorimeters are housed, the "oven-like" structure on the right being the "bed-calorimeter" into which a recumbent patient is inserted upon a stretcher. In the background is the "chair calorimeter," into which the subject enters by the roof, and in the foreground are placed the absorber systems and large balances used in measuring their increments of weight.



General View of the Calorimeter Room in the Nutrition Laborato y in Boston.

1 "Respiration Calorimeters for Studying the Respiratory Exchange and Energy Transformations of Man." By F. G. Benedict and T. M. Carpenter. Pp. viii+102. (Washington: Carnegie Institution, 1910.)

SEWAGE DISINFECTION.[1]

IN view of the prominence at present given to the question of the disinfection of sewage and sewage effluents, the publication of the results of Prof. Phelps's latest investigations on the subject is undoubtedly of great interest to those engaged in public-health work.

It is stated in the introduction that the investigations on which the report is based were conducted by the author at the Sanitary Research Laboratory and Sewage Experimental Station at Boston, Mass., and in collaboration with the author by Mr. Francis E. Daniels at the sewage disposal works at Red Bank, N.J., and by Mr. Ezra B. Whitman at

1 "The Disinfection of Sewage and Sewage Filter Effluents, with a Chapter on the Putrescibility and Stability of Sewage Effluents." By E. B. Phelps. Pp. 91; 39 tables, 1 plate. (Washington: Government Printing Office, 1909.)

the Walbrook testing plant at Baltimore, Md., under co-operative agreement with the Massachusetts Institute of Technology, the State Sewerage Commission of New Jersey, and the City Sewerage Commission of Baltimore.

After considering the various possible methods of disinfection, and referring to numerous investigations made in America, England, and on the Continent, the author concludes that, in the absence of further information in regard to the possibilities of heat (with consequent recovery of ammonia) and of organic compounds, chlorine compounds are most applicable in the case of the disinfection of sewage and sewage effluents. The authors' large-scale experiments were therefore confined to the disinfection, by means of chloride of lime, of sewage, septic sewage, and effluents from trickling filters.

In common with other workers, Prof. Phelps finds that whereas treatment with comparatively small quantities of chlorine fairly readily eliminates 95 per cent. or more of the total organisms present, complete sterilisation can only be obtained with difficulty and at relatively very much greater cost, which he concludes would render it impracticable for regular adoption. Pages 39 to 46 and 56 to 60 deal with the disinfection, by means of chloride of lime, of effluents from trickling filters at Boston and Baltimore respectively.

The experiments at Boston refer to the disinfection of the total effluent (5000 gallons in twenty-four hours) from two trickling filters 50 feet square and 8 feet deep. The work extended over a period of seven months, including both winter and summer months, so that the results obtained may be taken as average results under working conditions.

It was found that with two hours' storage the addition of 3·5 parts per million of available chlorine (in the form of bleaching powder) was sufficient to effect a reduction, on the average, of 96·8 per cent. and of 99·2 per cent. of the total organisms at 20° C. and of *coli* organisms respectively present.

In consequence of the greater purity of the Baltimore filter effluent, similar results to the above were obtained with the addition of less chlorine, viz. 2·2 parts of available chlorine per million.

As a result of the experiments on the disinfection of Boston sewage and of septic sewage at Red Bank, N.J., the author concludes that an average of 7 or 8 parts per million of available chlorine is sufficient to disinfect the sewage, whereas the septic sewage requires from 10 to 15 parts per million, this increased amount being mainly due to the presence of sulphuretted hydrogen.

On this account it is stated in the conclusions that where no purification is required beyond that given by septic action and by disinfection, it is advantageous to reverse the process by disinfecting the crude sewage before it enters the tank.

In this connection it is interesting to note the author's remarks on p. 56:—"There would be a great multiplication of bacteria in the tank, so that the number in the final effluent would probably be as great as in the raw sewage, and perhaps even greater. Nevertheless, the disinfection could be as effective on the pathogens as if it were applied as a final process. The subsequent development of saprophytes would have no sanitary significance, and would doubtless be of real value in the subsequent self-purification of the organic matter after it had been discharged into the stream."

The available evidence is favourable to this assumption, but further information is required in regard especially to the significance of the further development of organisms.

It is also interesting to observe that the investigations of the author have led him to revise his earlier views in regard to the use of electrolytic hypochlorites, and to conclude that, taking all things into consideration, it is preferable to use bleaching powder as a source of chlorine rather than to instal an electrolytic plant at the works. For many reasons this conclusion will meet with general approval on the part of those in charge of sewage works.

A table of carefully considered costs is given, on the basis of disinfecting 5,000,000 gallons per day by means of bleaching powder, from which it will be seen that the author estimates the total cost of treatment at from 2*s*. 2*d*. per million gallons (1*s*. 3*d*. cost of bleaching powder) for the addition of 1 part of available chlorine per million, to 21*s*. per million gallons (18*s*. 9*d*. cost of bleaching powder) for 15 parts of available chlorine per million.

These costs include the cost of chloride of lime, storage tanks, labour, &c., and are much lower than those given for treatment with electrolytic hypochlorites produced at the sewage works by Digby (the *Surveyor*, vol. xxx., No. 778, p. 687) and Shenton in 1906, and recently repeated by Shenton (the *Sanitary Record*, vol. xliii., No. 1013, 1909, p. 392), which vary from 3*s*. 9½*d*. per million gallons for the addition of 1 part available chlorine per million to 19*s*. for 5 parts available chlorine per million, exclusive of charges for plant, storage tanks, and labour.

This difference in cost is accounted for by the fact that the latter investigators estimate the cost of available chlorine produced electrolytically at the works at 10*d*. per kilogram, whereas, using bleaching powder, it should not exceed 3½*d*. per kilogram.

While Prof. Phelps's investigations afford very valuable information and add considerably to the literature on the subject of sterilisation of sewage and sewage effluents, his suggestions in regard to the degree of disinfection are open to objection, especially when applied to English conditions.

In considering this matter, the difference between American and English conditions must be borne in mind, not only in regard to the chemical composition and bacterial content of the sewage or effluent, but also to the probably more important point of the conditions of discharge.

Speaking generally, from both points of view American conditions are the more favourable, as not only is the sewage more dilute, but also, as a rule, the relative volume of the river into which the effluent is discharged is much greater than in the majority of English cases.

In the case of the Boston sewage experimented upon, the bacterial content was only 5,000,000 per c.c. as compared with from 20,000,000 to 30,000,000 per c.c. in the case of an average English domestic sewage.

Further, it has been found that English effluents of satisfactory chemical composition may contain as many as 100,000 *coli* organisms per c.c.

It is therefore doubtful whether such a degree of disinfection as proposed by the author might not in certain cases give rise to an undue sense of security, especially as no reference is made to the treatment of the large volumes of storm-water which are discharged direct to the rivers, from numerous storm-water overflows, a question which is intimately connected with the subject of the disinfection of sewage effluents.

In the final chapter is described some very interesting work carried out in connection with the methylene blue test proposed by Spitta. With preliminary standardisation for any particular effluent, this test would appear to afford, in a very simple manner, valuable information in regard to the stability of sewage effluents. As carried out by the author, the test allows finer distinctions to be drawn between stable and unstable effluents than is the case with the ordinary incubation test, which classes an effluent either as non-putrefactive or putrefactive, without reference to the degree of putrefaction. It would be interesting to know how far such a colour test is applicable to the effluents from trade sewage.

EDWARD ARDERN.

OCEANOGRAPHICAL INVESTIGATIONS IN THE ATLANTIC AND MEDITERRANEAN.

WE are informed that a Danish expedition has just set out from Copenhagen with the intention of carrying out renewed investigations along the Atlantic Slope and in the Mediterranean. The leader of the new expedition, as of the earlier Danish expeditions, will be Dr. Johs. Schmidt, who is well known for his previous Atlantic work, especially on the eel, and he will be accompanied by the following men of science:—J. W. Nielsen, hydrographer; C. H. Ostenfeld and O. Paulsen, plankton specialists; Sven Palitsch, specialist in chemistry from the Carlsberg Laboratory in Copenhagen; and a biological assistant. The vessel is the research steamer *Thor*, of the Danish Government. During the first part of the cruise,

in the waters of Iceland and the Færöes, the investigations will have a more official character, being carried out at the expense of the Danish Government and as part of the international scheme of work. The second part of the cruise will set out in the beginning of July from some English port. The expenses of this portion of the expedition will be defrayed partly by the Carlsberg Institution of Copenhagen, which does so much for the promotion of science in Denmark, partly from private sources.

Both in the Atlantic and Mediterranean the expedition will work over waters which have been already, for a great part, investigated by the *Thor*. It is not proposed to devote much time to the Atlantic region south of Ireland, and there is the less reason for doing so as previous workers, especially the Prince of Monaco, Schmidt, and the Irish investigators, have already done so much there. Nevertheless, a series of deep-sea hydrographical observations from the south of Ireland to the coast of Morocco, continuous with similar series from Iceland to Ireland and through the Mediterranean, will be of extreme interest, both in biological matters and as a further contribution towards understanding the circulation of the waters of the Atlantic and the adjacent seas.

In the Mediterranean, on the other hand, the hydrographical and biological conditions are only imperfectly understood. As is well known, the Mediterranean is an almost completely land-locked and independent ocean, with an average depth of more than 1000 fathoms, descending at places to 2000 fathoms. This huge basin is connected with the Atlantic at the Straits of Gibraltar by a narrow sill or threshold, which is only 200 fathoms deep. Any mixing of the Atlantic water with the Mediterranean water can therefore only proceed on the surface, and the renewal of the deeper layers, which is necessary for the development of an abyssal life, and which actually does take place, can only be due to the conditions, evaporation, convection currents, but mostly wind influence, prevailing in the Mediterranean itself. On the other hand, it seems certain from earlier investigations that the deep water of the Mediterranean, which is much more saline than the Atlantic, occasionally or normally wells up over the threshold at the Straits and flows out into the Atlantic as a deep-water current with a northerly direction. A further interesting topographical feature of the Mediterranean is that it is divided into two deep-water basins by a submarine ridge, which stretches across between Sicily and Tunis, and is only about 150 fathoms deep. The circulation of the waters within the two deep basins west and east of this ridge must therefore be for the most part independent. The determination of the character of the water in the two basins, in all layers from the surface to the bottom, promises results of more than usual interest.

The hydrographical observations will be of two kinds, physical and chemical. The temperature and salinity will be determined, as also the direction and strength of the currents, in all depths from surface to bottom, in accordance with the most modern methods employed by the international investigations. Entirely new methods have also been recently worked out by Danish men of science at the Carlsberg Laboratory in Copenhagen for the determination of the chemical composition of sea water, for example, the dissolved gases (O, N, CO_2) and the alkalinity (concentration of H-ions). It is probable that these new methods will throw fresh light upon the factors determining the differences in the occurrence and appearance of the organic life at different depths and in different waters, differences which the salinity and temperature by themselves cannot explain. It is obvious that the waters mentioned in the Atlantic and Mediterranean offer exceptional opportunities for such an investigation.

On the biological side, the investigations will be on the lines followed by the International Council for the Study of the Sea, and will be directed, in the first place, to the elucidation of the life-histories and biological conditions of the principal fishes. The advantage of making investigations over a wide area, as from Iceland to Morocco and the Mediterranean, is just that the differences in the physical conditions are marked on a large scale, and can be connected directly as cause to effect with the very distinct differences in the occurrences and biological phenomena of all organisms, from the floating plankton to the fishes. One of the most interesting problems here will thus be to determine the relation between the Atlantic and Mediterranean faunas, how far the latter is dependent, if at all, on the former, and the differences in the abyssal life of the two regions, all in connection with the physical and chemical differences.

A NEW AMPEREMETER.

A NEW aperiodic millivolt and amperemeter for continuous and alternating currents has been brought to our notice by Messrs. Isenthal and Co. The operation of the instrument is based on methods already described by Drude and Klemenčic, in which the current to be measured is caused to heat up thermojunctions, thus setting up indirectly a current which actuates the movement of the instrument. The novelty in the present instrument consists in the arrangement adopted for combining the action of a number of thermojunctions in such a manner that thermocurrents are produced of sufficient magnitude to deflect an ordinary pivoted moving-coil instrument.

The thermocouples are placed in the four arms of a Wheatstone's bridge, the movement being connected to two opposite corners of the bridge, and the leads carrying the current that is to be measured to the remaining corners. The polarities of the thermocouples are so chosen that when the bridge is warmed up by the passage of a current the electromotive forces set up in the four arms conspire so as to send a current through the movement. The arms of the bridge are adjusted so that the thermoelectric current passes through the movement without entering the external circuit, and the current from the external source passes through the thermocouples without affecting the galvanometer.

As the deflections of the instrument depend on the heating effect of the current to be measured, it should give correct readings for direct current or alternating current of any wave-shape or frequency. It seems that sources of error might be introduced by Peltier effects and changes of temperature of the surroundings, and it would be interesting to learn to what extent such errors are appreciable, and in what manner they have been compensated for.

The sensitiveness of the meter is 225 millivolts with a current of 1 ampere, and its range as an amperemeter can be increased to any extent by the use of shunts.

GEOLOGY OF THE LONDON DISTRICT.

THE Geological Survey cannot well be charged with neglect of London, except in the matter of six-inch maps, a want that will probably be soon seen to. From 1864 to 1906 various memoirs were issued which deal, though sometimes only partially, with the geology of London and the neighbourhood. Two of these, however, treat of the whole district and the whole of its geology, and now we have a third, in which the results reached by many workers are given up to date.

This memoir may be said to have been done by Mr. Woodward to celebrate his retirement from office, more than a year ago, and a remarkably good celebration it is. From its very low price it is within the reach of all students, and we may hope that its author may live to edit many editions.

The area described is that covered by the lately published four sheets of the new geological map of London, some errors in which are duly noted on p. v. After a general account of the area, five pages are given to an account of the various beds beneath the Chalk, which do not come to the surface here, their presence underground having been proved only by borings. These consist of Devonian rocks, at the base, Red Rocks of doubtful age,

[1] Memoirs of the Geological Survey. The Geology of the London District. By H. B. Woodward, F.R.S. Pp. viii + 142 + plate. (London: His Majesty's Stationery Office: E. Stanford: Edinburgh: W. and A. K. Johnston, Ltd. Dublin: Hodges, Figgis and Co., 1909. Price 1s.

Great Oolite beds, possibly some Lower Greensand, and in every boring Gault and Upper Greensand. The omissions in the series are notable; we have no certain Carboniferous rocks, only a possibility of Trias, no Lias, only one division of the great Jurassic series, and no Wealden beds, a perfect succession being reached only with the Gault.

To the description of the Chalk nine pages are given, and as the Middle and Lower divisions are found only underground, in borings, these are concerned chiefly with the Upper Chalk. The zones of the whole formation, with the distinctive fossils, are noted.

The Eocene Tertiaries, which form so large a part of the district, take twenty-five pages for their description, which are followed by four pages on faults and disturbances, after which the various members of the great Drift series, so greatly in evidence in the district, are described at some length, the Older Drifts with eleven pages to their credit, the Glacial (and allied) Drift with thirteen, whilst the description of the Valley Drifts, with their flint implements, extends to twenty-three pages.

The stratigraphic series ends with Recent beds, the Alluvium of the rivers being described in eight pages, after which the remaining ten pages of the chapter treat of some other matters, namely, a description of the Thames, its tributaries and its buried rivers, floods, fords, old trackways, a short account of the growth of London, and a summary of the physical changes in the district from the time of the deposit of the Chalk to the formation of the Alluvium.

The question of water-supply from the various beds is discussed in nine pages, and various other economic questions in other ten, which conclude the work, except for the lengthy index.

The plate is a contour-map of the district, with a geologic section from the valley of the Gade, on the north-west, to beyond that of the Darent, on the south-east.

At the end of the various subjects a list of the chief works relating to each is given, and this will be of much use to those who want further detail. But with this memoir in hand nearly everyone may know as much about the geology of London, using that name in a wide sense, as he needs to know.

ECONOMIC ENTOMOLOGY.

IN the last number of the *Journal of Economic Biology* (vol. v., pp. 9–17) Mr. W. E. Collinge gives some interesting notes on the form of the egg of the horse bot-fly (*Gastrophilus equi*), its attachment to the horse's hair, and the method of its hatching. The narrow end of the subconical egg is not simply glued to the hair; it clasps the hair by means of a pair of ridges or lips, so that the area of attachment is like that of the ox warble-fly (*Hypoderma bovis*), only less specialised. With regard to the mode of hatching, Mr. Collinge's observations and experiments confirm, in the main, the statements of Bracy Clark and Osborn. He found that the eggs were most readily induced to hatch, by the application of moisture, from sixteen to twenty days after hatching; none could be induced to hatch after thirty-six days.

Mr. R. Newstead describes in the same part (pp. 18–22) a couple of new species of Coccidæ from the Congo, which live as guests of ants (Cremastogaster and Sima) in their nests in the hollow shoots of plants. It is very rarely that insects of this family are found in the hollow stems of their food-plants. One specimen contained a minute lepidopterous larva which had partly destroyed its host.

It is well known that economic entomologists in North America are much troubled by the ravages of insects purposely or accidentally imported into their country from Europe; one of the most famous of these is the gipsy moth (*Porthetria dispar*). Dr. L. O. Howard has lately (U.S. Dept. Agric. Bur. Entom., Tech. Ser., 19) described some parasites reared from the eggs of this insect. It is remarkable that the parasites—various species of minute Hymenoptera—all come from Hungary, Russia, and Japan. From Gipsy-moth eggs imported from western Europe no parasites could be reared, and, though the moth has been in the United States for more than forty years, no American species is known to attack its eggs. "Non-parasitism of *P. dispar* by native species," writes Dr. Howard, "is probably due to the character of its egg-mass, which is so compact and so thoroughly protected by the scales of its parent as possibly to disguise its character from species unacquainted with it."

G. H. C.

ALTERATIONS OF THE DEVELOPMENT AND FORMS OF PLANTS AS A RESULT OF ENVIRONMENT.[1]

THE fungus Saprolegnia is chosen as an example among the lower plants. This fungus lives on dead insects, and shows three distinct stages of its development:—(1) vegetative growth of the mycelium; (2) asexual reproduction by motile zoospores; (3) sexual reproduction by male and female organs. Under ordinary conditions these three stages follow one another quite regularly until, after the ripening of the resting spores, the fungus dies; but, according to the special conditions of every stage, it is possible to produce them as we desire, and also to alter their succession. Under very favourable conditions of nutrition the fungus must continuously grow, without being propagating and without dying. Numerous other lower plants, as fungi and algæ, show the same relations to environment.

Flowering plants present far more difficulties, in consequence of their very complicated structure. *Sempervivum Funckii* is taken to show how far the development of such a plant depends on environment. Sempervivum appears as a short stem covered with thick sappy leaves; we call this form a *rosette*. The rosettes produce in an asexual way new daughter-rosettes, of which each comes to flower under suitable conditions, and dies after the ripening of seeds. The state of a plant, destined to flower but without recognisable rudiments, is called *ripe to flower*. The formation of the inflorescence consists of three essential stages:—(1) the lengthening of the stem; (2) the production of several branches at the top; (3) the birth of flowers.

Under very favourable conditions of nutrition, a rosette ripe to flower can be transformed again into a vegetative one, which must always grow without sexual reproduction. In blue light, during March and April, a lengthening of the rosette ripe to flower takes place, but without flowering. Such a lengthening of the stem is wholly independent of flowering, because all rosettes, also the youngest ones, are able to lengthen in red light. On the other hand, the flowers can result without lengthening when the rosettes are exposed to a high temperature. The production of flowering branches can be prevented, the inflorescence at the end having but a single flower. In other conditions numerous branches are to be found on the whole stem, even in the axils of the old leaves, particularly as the result of injuries.

We come to a new series of forms by replacing flowers by leaf-rosettes, which can be produced on all parts of the inflorescence, even on the flowering branches, alone or mingled with flowers. The plants, of which the inflorescence bears rosettes, do not die at the end of summer as is normal, but live another two or more years, appearing in peculiar forms. It can be shown that flowers vary in an exceedingly high degree under certain conditions. The number and arrangement of all members as sepals, petals, stamens, and carpels can be altered. Further striking variations of the normal forms appear in such artificially modified flowers by the transformation of sepals into petals, of petals into stamens, of stamens into petals and into carpels. Experiments were made to answer the question whether alterations of flowers can be transmitted. For such researches *Sempervivum acuminatum*, which produces easily ripe seeds, was used. The seeds of flowers artificially altered and self-fertilised gave rise to twenty-one seedlings, among which four showed surprising deviations in their flowers. With two seedlings all the flowers were greatly altered, and presented some of the alterations of the mother plant, especially the transformation of stamens into petals. The experiments are being continued.

[1] Abstract of the Croonian Lecture delivered at the Royal Society on May 26 by Prof. G. Klebs.

PLANTS OF SCOTTISH LOCHS.[1]

AN interesting account of the lochs of Kirkcudbrightshire, Wigtownshire, Fife, and Kinross, and the plants that grow in them and on their shores, is given by Mr. G. West in a paper recently published by the Royal Society of Edinburgh. This is the author's second paper on the botanical aspects of Scottish lochs, and includes many valuable details relating to the districts investigated. The systematic list of plants shows the distribution of each plant in all the areas studied, and other particulars. Details are given respecting the physical characteristics of each loch and its surroundings, and everything of interest is described from a botanical point of view, especially the plant associations.

FIG. 1.—An example of a wind-exposed highland loch—Loch Grennoch (by Cairnsmore of Fleet). View from the north-west end, looking south. The sandy bays are not well shown as the scale is so small. This loch has scarcely any littoral vegetation.

The lochs of north-west Kirkcudbrightshire are chiefly of the highland type, *i.e.* having considerable elevation above sea-level, water more or less peaty, barren sandy or stony shores, scarcity of those plants having leaves that float on the surface, and having such marsh vegetation as may exist chiefly on the western side, because, owing to the prevailing westerly winds, the erosive power of the waves on the eastern shores prevents the development of a littoral flora there, besides which many plants associated with the richer food supply of the lowland lochs are absent.

In south-east Kirkcudbrightshire there are comparatively few lochs, and these are mostly of the lowland type, *i.e.* having a relatively small elevation above sea-level, non-peaty water, muddy or marshy shores which are frequently covered with marsh plants, an abundance of plants with floating leaves, and, although large lowland lochs usually have their marsh vegetation chiefly on the western shores, such is not the case with small lowland lochs, besides which certain plants such as *Isoetes lacustris, Lobelia Dortmanna*, &c., which are usually associated with peaty water, are absent.

Wigtownshire, which is remarkable for its great tracts of treeless peat-moor, affords examples of both kinds of lochs. Those sheets of water that are situated on the open moors resemble highland lochs in their general features. Those lakes that are within the zone of active agriculture are decidedly of the lowland type.

In Fife and Kinross a few lochs of a semi-highland character may be found on the higher hills. The greater number of the lochs in this district, however, are distinctly of a lowland type, and many of them have a very rich flora, comparatively rare plants often occurring in great abundance; the greater number, however, have had their natural features considerably altered by the hand of man. In some parts new lochs have been created by the construction of dams, &c. In other places shallow sheets of water that could be put to no useful purpose have been drained, and the sites utilised for agriculture, whilst in a few cases lochs are used as receptacles for sewage. The only lochs of this area that retain their natural conditions are the smaller ones on the Cleish Hills.

On account of the comparative lack of knowledge respecting the ecology of aquatic and semi-aquatic plants, the author considers that it is premature to attempt at present the grouping and generalising of sets of observed phenomena relating to their distribution.

In the seven areas investigated, about 175 lochs have been visited; these vary in size from what are practically inland seas, such as Loch Ness, to mere ponds, like Lochan Diota. These lochs have to a considerable extent their individual floristic peculiarities, and this fact inhibits the process of condensation of such features into a short summary. The lochs may, of course, be grouped in accordance with their striking physical characteristics, such as elevation above sea-level, exposure to wind, nature of shore, depth of water, condition of the bottom, whether rocky, stony, sandy, clayey, muddy, &c., kind of water,

FIG. 2.—An example of a large loch the wind-sheltered western margin of which has an abundant vegetation—Loch Ken. View near New Galloway from the west shore looking north, showing a large association of *Nymphaea lutea* extending along the loch for about a quarter of a mile outside a zone of *Scirpus lacustris*. The water over the Nymphæ area is from 2 to 7 feet deep.

[1] "A Further Contribution to a Comparative Study of the Dominant Phanerogamic and Higher Cryptogamic Flora of Aquatic Habit in Scottish Lakes." By George West. With 62 plates. Proc. Roy. Soc. Edin., session 1909–10, vol. xxx., part ii., No. 6. Pp. 65–181. Price 14s. 3d.

whether peaty or non-peaty, rich or poor in plant food-salts, &c.; and these characters very largely depend upon the physiographical features of the surrounding country. When the combination of such factors respecting any loch is known, the plants likely to be found there may be roughly indicated, but this apparent simplicity is frequently modified by other agencies.

FIG. 3.—An example of a small, somewhat wind-sheltered semi-highland loch the western margin of which has a zone of marsh vegetation—Loch Dow, Cleish Hills. View of the west side from the south end, looking north-west, showing *Carex rostrata* bordering the west side of the loch. The darker patch standing out of the water on the right is an association of *Equisetum limosum*.

The laws which govern the geographical distribution of aquatic plants cannot be fully understood until science has revealed more facts regarding the ecology of the plants than it at present possesses; it is therefore futile to attempt the deduction of general laws, with only an inadequate knowledge of the phenomena to be generalised. During the last great Glacial epoch it is certain that all forms of the higher plants were banished from the greater portion of Scotland. Towards the end of that era, as the mantle of ice and snow began to retreat, so would plants encroach again over the country from the region to the south, where its influence had been less severe. What precise causes influenced most this gradual northward march of aquatic and terrestrial plants cannot now be determined, but probably they were such as affect the distribution of plants at the present day. The plants no doubt followed the lines of least resistance and greatest traction, not only in their geographical advance, but also in their adaptations of structure and function to the varying environments. These lines must necessarily be ramified and involved, perhaps to an insoluble degree; yet on them are the secrets of plant geography to be discovered, on the basis of physiological anatomy and plant psychology.

By such methods a most interesting inquiry would be, What is the equilibrium that has been attained between the forces of resistance and traction that has caused certain species to arrive at, and remain in, restricted areas? This is a subject bristling with difficult chemical and physical complications, combined with the various influences resulting from the never-ceasing action and reaction, not only between the different members and associations of the flora, but between the flora and fauna as well; and it is at present impossible to set down a complete satisfactory statement of the ecology of any single group of aquatic plants. We must, therefore, for the moment leave the final generalisation of the causes which govern the distribution of plants, and content ourselves with the routine work of taking evidence of that which occurs, not being too eager to surround ourselves with metaphysical hypotheses which seek to explain the observed phenomenon by a noumenon, nor to cloak our ignorance and delude our senses with vague concepts that transcend actual demonstration, and, when analysed, explain to our intelligence nothing whatever.

Again, the restriction of certain plants to particular localities may be accounted for by observing that they are ill adapted for any mode of dispersal to which they are likely to be subjected; it is then difficult to understand their introduction to their present situation. It is not easily explained why *Equisetum limosum, Carex rostrata, Phragmites communis*, and others, should be so widely distributed about the margins of all kinds of lochs, whereas *Cladium Mariscus*, an equally dominant species, should be restricted, in the areas under discussion, to a few places in Wigtownshire. When the subscience of plant-ecology has taught us the full facts regarding the relationship existing between organism and environment, then shall we be able to generalise sets of phenomena regarding the geographical distribution of water plants to some useful purpose.

The study of the plants of the lochs suggests that aquatic plants have not always had their origin from terrestrial forms that had been forced into the water by more robust competitors on the land, as is sometimes stated, but, more probably, because certain mutable forms have exhibited a tendency, as some do even now, to take on the aquatic habit, that mode of living being more agreeable to their requirements. Some plants form themselves into dense associations consisting of one species only, which spread over considerable areas, and not only prevent others from growing amongst them, but year by

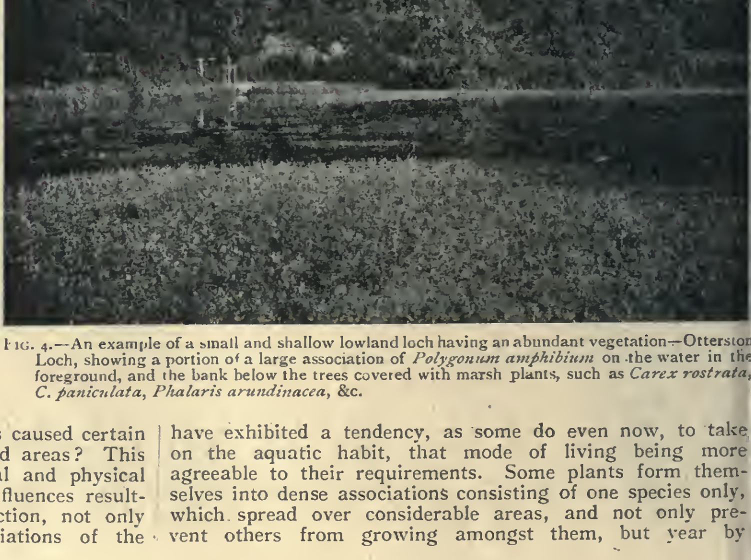


FIG. 4.—An example of a small and shallow lowland loch having an abundant vegetation—Otterston Loch, showing a portion of a large association of *Polygonum amphibium* on the water in the foreground, and the bank below the trees covered with marsh plants, such as *Carex rostrata*, *C. paniculata*, *Phalaris arundinacea*, &c.

year extend their borders at the expense of neighbouring plants. In the vanguard of such colonies there is doubtless very keen competition for the space, and the weaker or less suitably adapted species will be slowly driven before the stronger. This, however, is unlikely to go on continuously, because the stronger species will sooner or later meet with physical or chemical barriers which it is ill adapted to overcome, but to which the weaker species may be better adapted. Quite commonly, it is not that competition for available space is so great, but that the local conditions favour the dominant growth of a few individual species. One frequently finds normal terrestrial or marsh species taking on the aquatic habit: instance *Ranunculus Flammula, Juncus supinus, J. acutiflorus, Peplis Portula*, &c., but always of their own free will, so to speak, *i.e.* by the exercise of the subtle power of adaptability, which is more or less the common possession of all plants.

From another aspect of this interesting subject it appears that other causes for variation, with the consequent production of new forms, lie in the fact that although the conditions for plant life are so often remote from the ideal, yet the plastic power possessed by plants, enabling them to adapt themselves to the various combinations of edaphic and climatic conditions, is so great that there are comparatively few spots, where existence is possible, in which some plant or other is not able to thrive and carry on its metabolic activities. Now in order to maintain a proper tone of health, a plant has of necessity to respond in suitable ways to all the varying external impressions. A plant is therefore in a constant and continual state of change, owing to the never-ceasing mechanical, physical, and chemical changes of its unstable environment. The plastic nature of many plants enables them to modify their organs in reciprocation to any fairly constant set of environmental conditions, and it is in this endeavour to accommodate themselves for the maintenance of healthy existence in places that are either inhospitable or too luxurious that certain deviations, either fixed or transient, from the usual forms of more normal environments are to be accounted for, and such variations occur in almost every loch. That some of such variants may doubtless be concerned in the origin of new species and varieties is the impression received, but other causes also contribute towards that process.

The rapid increase of aquatic and marsh plants in reservoirs that are used for the public water supply is occasionally a matter of anxiety and expense to the owners. Enormous sums of money are frequently paid by public bodies for advice respecting the construction of reservoirs to persons wholly unacquainted with the local geological features, as well as with the flora and fauna of the district. Whilst it is very unwise to construct a reservoir over a geological fault and expect it to hold water (and this has been done), it is equally vain to make a shallow reservoir in the line of the constant migration of water-fowl (*i.e.* between their resorts) and expect it to maintain a freedom from water plants. The greatest depth at which aquatic plants will flourish in Scottish waters is about 40 feet. It is very unlikely, however, that the species capable of growing at such a depth will ever become a nuisance in a reservoir: but at a depth of 20 feet it will be found that, in suitable water, many species capable of giving trouble will flourish. Upon consideration of these facts, it seems advisable, as a prevention against the development of water plants, to construct reservoirs with sides so steep that a minimum depth of from 20 to 25 feet will be maintained within a few yards of the margin. Moreover, the sides, unless of natural rock, should be faced with stonework, which will further impede the growth of plants, as well as prevent discoloration of the water by wave-erosion.

The 124 figures contained in the present paper, together with the 110 which illustrate the author's previous publication on the same subject, form an interesting and instructive series of views of the vegetation of Scottish lochs from an ecological aspect.

In a comparative table the plants are arranged in seven ecological groups, in each of which the species found in peaty and non-peaty lochs are indicated with the depths at which they grow. The list of plants contains some new records for the districts.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor has published to the Senate a minute of the council of Trinity College supporting the plea for the establishment of a professorship of bio-chemistry, and stating that, with the view of making increased provision for higher teaching and research in that subject, pending the establishment of a professorship, the college has appointed Mr. F. G. Hopkins, at present reader in chemical physiology, to a prælectorship in bio-chemistry, and proposes to elect him to a fellowship.

The General Board of Studies will shortly proceed to appoint a university lecturer in mathematics in succession to Dr. Hobson. The appointment will be for five years from October 1, 1910. Candidates are requested to send their names, with testimonials if they think fit, to the Vice-Chancellor on or before Saturday, June 4.

Mr. R. H. Lock has been approved by the general board of studies for the degree of doctor in science.

Mr. A. J. N. Tremearne has been approved for the diploma in anthropology. This is the first time a diploma has been granted in this subject.

The board of agricultural studies, in consultation with the president of the Royal Agricultural Society, has nominated Mr. F. R. Salter to be the Gilbey lecturer on the history and economics of agriculture for one year from October 1, 1910.

AT the closing ceremony of session 1910–11 of the University College of North Wales, Bangor, to be held on Friday, June 24, Dr. J. J. Dobbie, F.R.S., principal of the Government Laboratories, London, will deliver an address on "Museums: their Aims and Methods."

ON Monday evening, May 23, on the invitation of the Rector of the University of Berne, Prof. Schäfer, of Edinburgh, gave a lecture on the functions of the pituitary body in the aula of the University before a large and appreciative audience. The lecture formed one of a series which was designed to commemorate the seventy-fifth anniversary of the re-founding of the University. In proposing a vote of thanks the Rector announced that the University had conferred the honorary degree of M.D. upon the lecturer, who was thereupon duly presented with the diploma.

STEPS are being taken by the Government of Queensland to invite applications in London for the professorial staff of the university shortly to be opened in that State. The chairs to be filled are classics, mathematics and physics, chemistry, and engineering. Applications will shortly be invited by Major T. B. Robinson, the Agent-General in London, from gentlemen competent to fill the positions. The salary of each professor is to be 900*l.* a year. The Government of Queensland will contribute 10,000*l.* a year for the next seven years to the University. Arts, science, and engineering will be the three great faculties, and the proposal in the first Bill that commerce was to be a faculty, with a lecturer and a degree of B.Com., has disappeared.

PROF. RUDOLF TOMBO, jun., of Columbia University, contributes to *Science* of May 6 some interesting statistics of certain Continental universities. During the winter of 1909–10 there were 58,342 students in attendance at German universities, 93·5 per cent. of these being men and 6·5 per cent. women. The matriculated students constituted 90·8 per cent. of the grand total, the remainder being auditors. The largest number of German students were to be found at Berlin, which had a total of 10,319; the next six out of the 21 German universities with their number of students were Munich, 7321; Leipzig, 5630; Bonn, 3880; Breslau, 2759; Halle, 2660; and Göttingen, 2342. Berlin attracted the largest number of matriculated women, and was followed by Munich, Göttingen, Heidelberg, and Bonn. Vienna is by far the largest of the Austrian universities, being surpassed in point of attendance (9580) only by Berlin among German institutions, while the University of Berne (2507) is the most largely attended of Swiss universities. If the attendance at the German universities during the winter of 1909–10 be compared with that of 1893–4, it is found that the number of matriculated

students has more than doubled during this period, the gain being one of 113 per cent., that is, from 27,424 to 58,342. There has been a marked change, too, in the relative position of the various German universities since 1893–4, when the largest universities were, in order, Berlin, Munich, Leipzig, Halle, Würzburg, Bonn, and Breslau. The only university that shows a decrease in the attendance of matriculated students as against 1894 is Würzburg, and there the loss is very slight.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 5.—Mr. A. B. Kempe, treasurer and vice-president, in the chair.—Colonel Sir David **Bruce**, Captains A. E. **Hamerton** and H. R. **Bateman**, and Captain F. P. **Mackie**: The development of trypanosomes in tsetse-flies. Until the end of 1908 it was believed that tsetse-flies acted merely as mechanical agents in the transference of trypanosome diseases. The parasite was supposed to be carried by the fly in the same way that vaccine lymph is carried—on the point of a lancet from one child's arm to another. The limit of time of infectivity of the fly was placed at forty-eight hours, and it was believed that if an infected area were emptied of its sleeping-sickness inhabitants for a couple of days, it would then be quite safe for healthy persons to enter it. At the end of 1908 Kleine made the discovery that a tsetse-fly could convey a trypanosome for some fifty days after the fly had fed on an infected animal. The experiments were carried out on these lines in Uganda. Both lake-shore and laboratory-bred flies (*Glossina palpalis*) were used, and various trypanosome diseases besides sleeping sickness were experimented with. Tsetse-flies are numerous on the lake-shore, 500 or more being caught every day by a few fly-boys. The flies brought up from the lake-shore were found to be naturally infected with at least two species of pathogenic trypanosomes, so that it was afterwards found necessary to use flies bred in the laboratory from pupæ gathered on the lake-shore. At first it was difficult to find these pupæ, but after some time the supply was more than sufficient, as many as 7000 being brought up in one day by a few natives. These experiments go to show that a late development of trypanosomes takes place in about 5 per cent. of the flies used. This development of trypanosomes in the inside of a fly renders the fly infective and capable of giving the disease to the animals it feeds on. The shortest time which elapsed before a fly became infective after feeding on an animal infected with sleeping sickness was eighteen days, the longest fifty-three days, and the average thirty-four days. An infected fly has been kept alive in the laboratory for seventy-five days, and remained infective during that time. It is not known how long the tsetse-fly may live under natural conditions on the lake-shore. Experiments made to test directly the duration of the infectivity of tsetse-flies show that they can retain their infectivity for at least two years after the native population has been removed from the fly area.—Dr. H. G. **Chapman**: The weight of precipitate obtainable in precipitin interactions.—Miss Ida F. **Homfray**: The absorption of gases by charcoal. The experimental portion of the work here summarised consisted in determining the volumes of gas absorbed by a known weight of charcoal, 3 grams, at definite temperatures, varying from that of liquid air to that of boiling aniline, and at pressures up to 80 cm. of mercury. The gases used were He, A, N_2, CO, CH_4, C_2H_4, CO_2, O_2, and mixtures of N_2 and CO. After making all necessary corrections, the isothermals were constructed, and from them points of equal absorption were read off, the family of curves so obtained being termed the isosteric diagram. The concentration for each isostere was calculated in the form

$$C = \frac{w \times 100}{W + w},$$

where w is the weight of gas absorbed and W that of the gas-free charcoal. The concentration of pure gas when $W = 0$ thus becomes 100 per cent. Two relations have been obtained which hold, within experimental accuracy, for all these gases:—(1) each isostere follows Ramsay and Young's rule for saturated vapours,

$$\frac{T_0}{T_1} - \frac{T'_0}{T'_1} = R\,(T_0 - T'_0),$$

and is expressible by Bertrand's vapour-pressure formula, (2) at constant pressure $dT/d \log C = K$. Also, in all cases at low pressures, and in some cases at all pressures, when these straight lines are produced to $\log C = 2$, *i.e.* 100 per cent., the corresponding temperature is found to be the recognised boiling point of the liquefied gas at that pressure. By means of a simple formula the heats of absorption at various concentrations were calculated, and the thermodynamical relations are comparable to those of concentrated solutions. Calorimetric measurements were made in the case of CO_2, and found to agree well with the calculated values. The suggestion put forward, as a result of the experimental work, is that a homogeneous solution phase is formed in equilibrium with the gas phase, the presence of a large concentration of charcoal greatly raising the equilibrium temperature of the volatile component at a given pressure. This rise is not constant, as in the case of dilute solutions, but is itself inversely proportional to the gas concentration. If any other function of the quantity of charcoal, such as its surface area, were substituted for the mass in calculating the concentrations, the relations between the absorption results and the constants for the liquefied gases would be lost. For mixtures of two gases in charcoal the phase rule holds, and the relations can be deduced from those of the components.

Royal Meteorological Society, May 25.—Mr. H. Mellish, president, in the chair.—W. C. **Nash**: The daily rainfall at the Royal Observatory, Greenwich, 1841–1903. From the statistics given in this paper it was shown that the average annual rainfall for the sixty-three years was 24·19 inches with 157 rain days. The day with the maximum number of rain days to its credit is December 5, while the days with the least number of rain days are April 18, 19, June 27, and September 13. There were ninety-four occasions during the whole period on which the rainfall exceeded 1 inch in the day. The greatest fall was 3·67 inches, on July 26, 1867.—L. C. W. **Bonacina**: Low-temperature periods during the winters 1908–9 and 1909–10. It is often observed that if a given week, month, or other period in one year is marked by some very special meteorological character with respect to one or more elements of weather, the corresponding period the following year shows exactly the opposite character. Dealing with the last two winters, the author directed attention to four very remarkable frosts which stand out prominently, viz.:—(1) December, 1908, in the south of England; (2) March, 1909, in the south of England; (3) November, 1909, in Scotland and Ireland; and (4) January, 1910, in Scotland and the north of England.—R. **Corless**: The rate of rainfall at Kew in 1908. A method was described of obtaining information about the rate of fall of rain from the records of a self-recording rain-gauge, which yields a continuous trace showing, by the position of the pen, the amount of rain fallen.

PARIS.

Academy of Sciences, May 25.—M. Émile Picard in the chair.—Remarks by the president on the forthcoming meeting of the International Association of Academies at Rome.—H. **Deslandres**: The influence of comets on the terrestrial atmosphere according to the kathodic theory. The study of Morehouse's comet showed that the whole of the light emitted by the tail was of kathodic origin, and it is highly probable that the tails of comets emit penetrating rays analogous to the γ rays of radium. These rays could ionise the atmosphere and cause the immediate condensation of supersaturated water vapour. Hence a connection is at least possible on this theory between Halley's comet and the weather.—P. **Villard** and H. **Abraham**: The existence of two explosive potentials. For a given system of electrodes two explosive potentials exist. The first is the potential of the brush discharge, the second appears to be the normal explosive potential and is more definite. Between these two limits there is a continuous silent discharge.—A. **Haller** and A. **Comtesse**:

The action of the bromides of *ortho-* and *para*-anisylmagnesium upon anthraquinone and β-methylanthraquinone. In these reactions substitution derivatives are formed in all respects analogous with those obtained with phenylmagnesium bromide and quinones. The reduction products of the diols obtained are also described.—Ch. **André**: The passage of the earth through the tail of Halley's comet. Observations with both the electrometer and magnetometer gave negative results.—M. **de Kerillis**: The aurora borealis. Laws and heliodynamical theories. Observations are discussed tending to prove the accuracy of the heliodynamical theory of the aurora.—A. **Blondel**: Observation of Halley's comet made at the Toulouse Observatory with the Brunner Henry equatorial of 38-cm. aperture. The apparent position of the comet and the comparison star are given for May 8.—Léopold **Féjer**: The partial sums of Fourier's series.—G. **Sagnac**: The interference of two beams superposed in the inverse sense along an optical circuit of large dimensions. The arrangement figured resembles that of Michelson in using half-silvered plates, the path of the rays being 30 metres. Some of the inconveniences of silvered glass interferometers are discussed.—A. **Chassy**: The absorption of energy by the passage of an alternating current through a gas at atmospheric pressure. The energy has been measured by the amount of heat developed; above a certain potential the heat developed is proportional to the intensity of the current.—Paul **Jégou**: A very sensitive electrolytic detector working without an auxiliary electromotive force. One of the platinum electrodes is replaced by a mercury-tin amalgam. The detector has a sensibility of the same order as the ordinary form, is invariable with the time, and is unaffected by vibrations.—Pierre **Sève**: A new model balance for the determination of magnetic fields. The apparatus described and figured is an improved form of the instrument designed by Cotton and made by Weber.—Georges **Claude**: The composition of the atmosphere after the passage of Halley's comet. A determination of the proportion of (helium + neon) showed no variation.—A. **Lafay**: A modification of the resistance of the air produced by roughnesses suitably arranged on the surface of a body. The experimental results given have a bearing on the problem of aërodynamics.—Georges **Meslin**: The structure of the lines of the spectrum.—C. **Chéneveau**: The precision of the measurement of magnetic susceptibilities. A discussion of a method recently proposed by M. Pascal.—Louis **Malclès**: The effect of penetration in dielectrics.—M. **Barre**: The solubility of silver sulphate in alkaline sulphates.—E. **Briner** and A. **Wroczynski**: The chemical action of high pressures: the compression of nitrous oxide and a mixture of nitrogen and hydrogen: the decomposition of carbon monoxide by pressure. No change was observed for nitrous oxide after compressing to 600 atmospheres at a temperature of 420° C. Negative results were also obtained with a mixture of hydrogen and nitrogen up to pressures of 900 atmospheres. Carbon monoxide showed clear evidence of chemical change after exposure to a temperature of 320° C. under a pressure of 400 atmospheres.—Daniel **Berthelot** and Henri **Gaudechon**: The chemical effects of the ultra-violet rays on gaseous bodies. On exposure to the ultra-violet rays a mixture of cyanogen and oxygen was nearly quantitatively converted into carbon dioxide and nitrogen. Ammonia mixed with oxygen gave as a final product water, nitrogen, and hydrogen. Hydrogen does not combine with oxygen under these conditions. Formic acid was identified amongst the products of the reaction with a mixture of acetylene and oxygen.—Georges **Denigès**: The presence of tartaric residues of wine in an ancient flask. The flask dated from the first century. Tartaric acid was detected in the deposit on the sides, proving that wine was originally placed in the flask.—P. **Clausmann**: The action of ozone upon carbon monoxide. The interaction of carbon monoxide with ozone produces carbon dioxide. The oxidation is increased by exposure to light and by the presence of moisture.—H. **Cousin** and H. **Hérissey**: Dehydrodicarvacrol.—J. B. **Senderens**: Ketones derived from benzoic and phenylacetic acids. The properties of a series of ketones prepared by the general catalytic method described in a previous paper.—N. **Chercheffsky**: The determination of the place of origin of a naphtha or of substances derived from it.—H. **Gault**: The condensation of ethyl oxalate with ethyl tricarballylate.—H. **Pariselle**: A new synthesis of natural and racemic erythrite.—W. **Louguinine** and G. **Dupont**: The heat of fixation of some ethylenic compounds. The hydrobromic acid was used in xylene solution, as much more concordant results were obtained with this than with aqueous hydrobromic acid.—Ernest F. L. **Marchand**: *Plasmodiophora brassicae*, a parasite of the melon and of celery.—J. **Capus** and J. **Feytaud**: A method of treatment against Cochylis and Eudemis. These Microlepidoptera are parasitic to the grape, and in recent years have caused great damage. The results of two modes of treatment are given.—R. **Robinson**: Re-section of the affluent veins.—M. **Hallopeau**: General considerations on the evolution of the treponeme in the human organism.—E. **Fauré-Frémiet**: Physico-chemical study on the structure of the nucleus of the granular type.—C. **Gerber**: Comparison between the mode of action of certain retarding salts and of the proteins of milk coagulable by heat on the caseification by ferments of boiled milk.—M. **Javillier**: The migration of the alkaloids in grafts of Solanaceæ.—M. and Mme. M. **Rosenblatt**: The influence of the concentration in saccharose on the paralysing action of certain acids in alcoholic fermentation.—H. **Bierry** and Albert **Ranc**: The diastatic hydrolysis of some derivatives of lactose. The lactase contained in the gastro-intestinal juice from *Helix pomatia* possesses unusual powers of hydrolysis, as it splits up, not only lactose, but several lactose derivatives, including lactobionic acid, lactosazone, lactose-amidoguanidine, lactose-urea, and lactose-semicarbazone. Galactose is in all cases one of the products, and this agrees with the views of E. Fischer, who regards lactose as a galactoside of glucose.—M. **Smoluchowski**: The mechanical theory of glacial erosion. A criticism and development of the theory put forward by M. de Martonne.—Alfred **Angot**: The magnetic and electric variations on the nights of May 18 and 19, 1910. None of the variations noted can be regarded as exceptional.—J. A. **Lebel**: Observation of the ionisation of the air in a closed vessel during the passage of Halley's comet.—C. **Limb** and T. **Nanty**: Observations of the magnetic variometers of the Observatory of Fourvière, at Lyons, during the night May 18–19. The variations were of the same order as those usually observed.—F. **Garrigou**: The presence of metalloids and metals in potable waters.—J. **Thoulet**: The measurement of the colour of marine vases.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part i. for 1910, contains the following memoirs communicated to the society:—

December 4, 1909.—W. H. **Perkin** and O. **Wallach**: Researches from the Göttingen University laboratory, xxiii.; on Δ^3-menthenol.

January 15, 1910.—W. **Schnee**: The formula representing the coefficients in the theory of Dirichlet series.

January 29.—E. **Madelung**: Molecular free-vibrations (supplementary paper).

February 26.—P. **Kolbe**: Hilbert's method of uniformisation.—L. **Bieberbach**: The movement-groups of the *n*-dimensional Euclidean space with a finite fundamental region.—O. **Haupt**: Remarks on oscillation-theorems, a letter to Prof. Klein.

FORTHCOMING CONGRESSES.

JUNE 19–23.—International Congress of Mining, Metallurgy, Applied Mechanics and Practical Geology. Düsseldorf. General Secretaries: Dr. Schrödter and Mr. Löwenstein, Jacobi-strasse 3/5, Düsseldorf, Germany.

JULY 4–8.—International Congress in Naval Architecture and Marine Engineering. London. Secretary: 5 Adelphi Terrace, London, W.C.

JULY 10–25.—International American Scientific Congress. Buenos Aires. Address for inquiries: President of the Executive Committee, c/o Argentine Scientific Society, 269 Calle Cevallos, Buenos Aires.

JULY 27–31.—International Congress on the Administrative Sciences. Brussels. Secretary of British Committee: Mr. G. Montague Harris, Caxton House, Westminster.

AUGUST 1–6.—International Congress of Entomology. Brussels. Chairman of Local Committee for Great Britain: Dr. G. B. Longstaff, Highlands, Putney Heath, S.W.

AUGUST 1–7.—French Association for the Advancement of Science. Toulouse. President: Prof. Gariel. Address of Secretary: 28 rue Serpente, Paris.

AUGUST.—International Congress of Photography. Brussels. Correspondent for United Kingdom: Mr. Chapman Jones, 11 Eaton Rise, Ealing, W.

AUGUST 2-7.—International Congress on School Hygiene. Paris. General Secretary: Dr. Dufestel, 10 Boulevard Magenta, Paris. Hon. Secretaries for Great Britain: Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.

AUGUST 15-20.—International Zoological Congress. Graz (Austria). President: Prof. Ludwig von Graff. Address for inquiries: Präsidium des VIII. Internationalen Zoologen-Kongresses, Universitätsplatz 2, Graz (Österreich).

AUGUST 18-26.—International Geological Congress. Stockholm. General Secretary: Prof. J. G. Andersson, Stockholm 3.

AUGUST 29 TO SEPTEMBER 6.—International Union for Cooperation in Solar Research. Mount Wilson Solar Observatory. British Member of Executive Committee to whom inquiries should be addressed: Prof. A. Schuster, F.R.S., Victoria Park, Manchester.

AUGUST 31 TO SEPTEMBER 7.—British Association. Sheffield. President: Prof. T. G. Bonney, F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

SEPTEMBER 6-8.—International Congress of Radiology and Electricity. Brussels. General Secretary: Dr. J. Daniel, 1 rue de la Prévôte, Brussels. Correspondents for United Kingdom: Prof. Rutherford and Dr. W. Makower, University of Manchester, and Dr. W. Deane Butcher, Holyrood, Ealing, W.

SEPTEMBER 18-24.—German Association of Naturalists and Physicians. Königsberg. Secretaries: Prof. Lichtheim and Prof. F. Meyer, Drummstr. 25-29, Königsberg.

SEPTEMBER 27-30.—International Physiological Congress. Vienna. President: Prof. S. Exner. General Secretary for United Kingdom: Prof. E. B. Starling, University College, London, W.C.

OCTOBER 6-12.—Congrès International du Froid. Vienna. Correspondent for United Kingdom: Mr. R. M. Leonard, 3 Oxford Court, Cannon Street, E.C.

DIARY OF SOCIETIES.

THURSDAY, JUNE 2.

ROYAL SOCIETY, at 4.30.—The Influence of Bacterial Endotoxins on Phagocytosis (Preliminary Report): Leonard S. Dudgeon, P. N. Panton, and H. A. F. Wilson.—The Origin of Osmotic Effects. III., The Function of Hormones in Stimulating Enzymic Change in Relation to Narcosis and the Phenomena of Degenerative and Regenerative Change in Living Structures: Prof. H. E. Armstrong, F.R.S., and E. Frankland Armstrong.—On the Direction of Motion of an Electron ejected from an Atom by Ultra-violet Light: Dr. R. D. Kleeman.—On Scandium. Part II.: Sir William Crookes, For.Sec.R.S.—The Flow of Water in Curved Pipes: Prof. J. Eustice.—On the Occurrence of a Mesocœlic Recess in the Human Brain and its Relation to the Sub-commissural Organ of Lower Vertebrates; with special reference to the Distribution of Reissner's Fibre in the Vertebrate Series and its Possible Function: Prof. A. Dendy, F.R.S., and G. E. Nicholls.

ROYAL INSTITUTION, at 3.—Malaria: Major Ronald Ross, F.R.S.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—Presidential Address: Dr. J. B. Simpson.—A Storage-battery Extension to a Three-phase Colliery Power-plant: W. Maurice.—On Measurements of the Downward Increase of Temperature in Bore-holes, their Technics and their Practical Importance for Geological Prognosis: Prof. J. Koenigsberger and Dr. Max Mühlberg.

LINNEAN SOCIETY, at 8.—A Contribution to our Knowledge of the Flora of Gazaland: Dr. A. B. Rendle, F.R.S., and others.

RÖNTGEN SOCIETY, at 8.15.—Practical Observations on Every-day X-Ray and Electrical Work: Filtration of Rays, Rapid Stereoscopic Method: Dr. Howard Pirie.—Recent Improvements in Radiographic Technique: Dr. R. Knox.

FRIDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—The World of Plants before the Appearance of Flowers: Dr. D. H. Scott, F.R.S.

ROYAL INSTITUTION, at 9.—Renaissance Monuments in the Roman Churches, and their Authors: Sir Rennell Rodd, G.C.V.O., K.C.M.G.

INSTITUTION OF MINING ENGINEERS, at 10 a.m.—Experiments illustrative of the Imflammability of Mixtures of Coal-dust and Air: Prof. P. Phillips Bedson.—Testing for Fire-damp: Prof. J. Cadman.—Some Memoranda concerning Coal-dust: H. W. G. Halbaum.

GEOLOGISTS' ASSOCIATION, at 8.—A Preliminary Account of the British Fossil Voles and Lemmings; with some Remarks on the Pleistocene Climate and Geography: M. A. C. Hinton.—Notes on some Igneous Rocks from North Devonshire: H. Dewey.

SATURDAY, JUNE 4.

ROYAL INSTITUTION, at 3.—Electric Heating and Pyrometry: Prof. J. A. Fleming, F.R.S.

MONDAY, JUNE 6.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Yolo-Cross River Boundary Commission, Southern Nigeria: Major G. F. A. Whitlock, R.E.—Journeys in Southern Nigeria: P. A. Talbot.

VICTORIA INSTITUTE, at 4.30.—Determinism: Archdeacon Potter.

ARISTOTELIAN SOCIETY, at 8.—The Nature of Propositions: Sydney Waterlow.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Accuracy obtainable in Fuel Calorimetry: G. N. Huntly.—Differential Distillation: J. L. Foucar.—The Production of Formic Acid by the Atmospheric Oxidation of Turpentine: C. T. Kingzett and R. C. Woodcock.—Proposed Method for the Estimation of Butter Fat, Cocoa Nut Oil, Palm Kernel Oil and the Determination of their respective Proportions in Mixtures: S. H. Blichfeldt.—The first Synthesis of Ethyl Alcohol: Prof. R. Meldola, F.R.S.

TUESDAY, JUNE 7.

ROYAL INSTITUTION, at 3.—Heredity in Tudor and Stuart Portraits: C. J. Holmes.

MINERALOGICAL SOCIETY, at 5.30.—On the Occurrence of Phenakite in Cornwall: A. Russell.—(1) Phacolite from near Belfast; (2) Crystalline Form of Nitrogen Sulphide: Dr. G. F. H. Smith.—On a new Arsenate and Phosphate of Lime and Strontia from the Indian Maganese Deposits: Dr. G. F. H. Smith and Dr. G. T. Prior.—A (fifth) List of New Mineral Names: L. J. Spencer.

THURSDAY, JUNE 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Distribution of Velocity in the β-Rays from a Radio-active Substance: J. A. Gray.—The Decrease of Velocity of the β-Particles on Passing through Matter: W. Wilson.—Rate of Emission of α-Particles from Uranium and its Products: J. N. Brown.—The Effect of Small Traces of Water Vapour on the Velocities of Ions produced by Röntgen Rays: R. T. Lattey.—On the Variation with Temperature of the Viscosities of the Gases of the Argon Group: Dr. A. O. Rankine.—The Effect of Pressure upon Arc Spectra. Part II., No. 4, Gold: Dr. W. G. Duffield.

MATHEMATICAL SOCIETY, at 5.30.—A New Method in the Theory of Integration: Dr. W. H. Young.—The Composition of Finite Screw Displacements: G. T. Bennett.—Note on the Theory of Linear Differential Equations: Prof. M. J. M. Hill.—The Generation of Cubic Curves by Apolar Pencils of Lines: W. P. Milne.—On Semi-integrals and Oscillating Successions of Functions: Dr. W. H. Young.

ROYAL INSTITUTION, at 3.—Malaria: Major Ronald Ross, F.R.S.

FRIDAY, JUNE 10.

ROYAL INSTITUTION, at 9.—The Progressive Disclosure of the Entire Atmosphere of the Sun (in French): Dr. H. Deslandres.

PHYSICAL SOCIETY, at 8.—A Galvanometer for Alternate Current Circuits: Dr. W. E. Sumpner and W. C. S. Phillips.—The Positive Electrification due to Heating Aluminium Phosphate: A. E. Garrett.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—A Revision of the Species of the Family Pyramidellidæ occurring in the Persian Gulf, Gulf of Oman, and the North Arabian Sea: Dr. J. Cosmo Melvill.—The Anatomy of *Hemiplecta foullioyi* from New Guinea: R. H. Burne.—Further Notes on the Dates of Issue of Sowerby's "Conchological Illustrations": A. Reynell.

SATURDAY, JUNE 11.

ROYAL INSTITUTION, at 3.—Electric Heating and Pyrometry: Prof. J. A. Fleming, F.R.S.

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THURSDAY, JUNE 9, 1910.

HANDBOOKS ON THE FRESH-WATER FAUNA OF GERMANY.

Die Süsswasserfauna Deutschlands, eine Exkursionsfauna. Herausgegeben von Prof. Brauer (Berlin). i., Mammalia, Aves, Reptilia, Amphibia, Pisces, by P. Matschie, A. Reichenow, G. Tornier, P. Pappenheim. Pp. iv+206; 173 figs. Price 5 marks. iii. and iv., Coleoptera, by E. Reitter. Pp. 235; 101 figs. Price 5 marks. v. and vi., Trichoptera, by G. Ulmer. Pp. 326; 467 figs. Price 6.50 marks. vii., Collembola, Neuroptera, Hymenoptera, Rhynchota, by R. and H. Heymons and Th. Kuhlgatz. Pp. 112; 111 figs. Price 2.40 marks. viii., Ephemerida, Plecoptera, Lepidoptera, by Fr. Klapálek and K. Grünberg. Pp. 163; 260 figs. Price 4 marks. ix., Odonata, by F. Ris. Pp. 67; 79 figs. Price 2 marks. x., Phyllopoda, by L. Keilhack. Pp. iv+112; 265 figs. Price 3 marks. xi., Copepoda, Ostracoda, Malacostraca, by C. van Douwe, E. Neresheimer, V. Vávra, and L. Keilhack. Pp. 136; 505 figs. Price 3.50 marks. xii., Araneæ, Acarina, and Tardigrada, by F. Dahl, F. Koenike, and A. Brauer. Pp. 191; 280 figs. Price 4 marks. xvii., Parasitische Plattwürmer, i., Trematodes, by M. Lühe. Pp. iv+217; 188 figs. Price 5 marks. xix., Mollusca, Nemertini, Bryozoa, Turbellaria, Tricladida, Spongillidæ, Hydrozoa, by J. Thiele, R. Hartmeyer, L. von Graff, L. Böhmig, W. Weltner, and A. Brauer. Pp. 199; 346 figs. Price 4 marks. (Jena: Gustav Fischer, 1909.)

THE aim of the editor of these volumes has been to provide a *complete* systematic account of the fresh-water fauna of Germany. In addition to the parts named above, others, on the Diptera, Oligochæta and Hirudinea, Rotatoria and Gastrotricha, Nemathelminthes and Cestodes are promised in the near future; a volume on the Protozoa is not at present in preparation, but may be forthcoming later. There are already other accounts which deal with portions of the fresh-water fauna, the organisms therein considered being selected either because they are the commonest fresh-water animals or because of their special interest from a biological or morphological point of view. But in the volumes before us *all* the known species of each group of fresh-water animals are considered; thus the worker is given the means of identifying any organism he may have under examination provided that it has been already recorded from fresh water in Germany. Whatever piece of work the fresh-water naturalist may desire to undertake, whether it be the study of the life-history of certain animals, their distribution, their behaviour under different conditions of environment, or whether it be the intensive study of the fauna of one pond or the more general study of the fauna of a more extended area, one of the first things necessary will be the determination of the systematic position of the organisms he proposes to investigate. For the first time the naturalist is provided, in this series of handy volumes, each written by a specialist or group of specialists, with the means of identifying his specimens with the minimum of difficulty and trouble, and without the necessity of consulting expensive monographs. The descriptions and diagnoses given are thoroughly trustworthy and practical; they contain the principal morphological characters, and short biological and faunistic notes are added in many cases. These handbooks are not intended to supply, and do not give, lengthy anatomical or biological accounts of the organisms; their function is to enable the worker who consults them to identify his material as speedily as possible. To this end keys are provided, wherever possible, to the families, genera and species, and figures, for the most part in line, are given to illustrate the diagnostic characters.

As there are no definite boundaries between the fresh-water, terrestrial, and marine faunas, it is difficult to decide whether certain animals should or should not be regarded as coming within the scope of these volumes. The editor has included not only animals which live in or upon fresh water, but those which are found on the margins of ponds, lakes, streams, &c., entering into intimate association with the water; others which seek the water only temporarily have been excluded. On the whole, the limits of the fresh-water fauna have been liberally interpreted. In order to give a more complete account, mention has been made in some cases of developmental stages of organisms, although these stages do not actually occur in fresh water; for instance, the larvæ—Leptocephali—of the eel are mentioned and figured. Our knowledge of some divisions of the fresh-water fauna is at present in a very imperfect condition; the adult forms of many animals are well known, while their younger stages are but inadequately described. These volumes, which will reach the hands of the majority of serious workers, will fulfil the purpose, among others, of serving as a record of our present knowledge, and will show the lacunæ which remain to be filled by future observations.

Heft i. deals with the whole of the vertebrates found associated with fresh water in Germany. The treatment of the Amphibia may be instanced as an example of the method adopted in this volume. A table of the diagnostic characters of adult Urodeles is given, by means of which *Salamandra maculosa, Molge alpestris, palmata, cristata,* and *vulgaris* may be distinguished. In the following part, which deals with the Batrachia, there are tables for the identification of (1) the fully adult frogs, *Hyla arborea, Bufo viridis, vulgaris,* and *calamites, Rana temporaria, arvalis,* and *esculenta* (three varieties), *Bombinator pachypus* and *igneus, Pelobates fuscus,* and *Alytes obstetricans*; (2) their spawn; (3) the young tadpoles with external gills; and (4) older tadpoles with internal gills. The third table is accompanied by the suggestion that it should be used only in case of those specimens which die in this comparatively early stage of development, and that it is preferable, wherever possible, to keep the tadpoles alive until the fourth table can be applied, with more certainty, to their identification. These four tables are illustrated by

forty figures, which clearly show the features upon which the diagnosis depends.

Hefte iii. and iv. form a single volume on the Coleoptera. The introductory pages contain useful figures, on which the structures used in diagnosis are named. The order is divided into Adephaga (Carnivora) and Polyphaga; then follow tables for the separation of the families, genera, and species. Th true water beetles, that is, those species in which all stages are passed in water, are first considered; afterwards, those species in which the young stages are found in water, the adults being terrestrial; and, finally, those the whole life of which is passed under stones or on plants on the margin of water.

The single volume on the Trichoptera (Hefte v. and vi.) opens with a detailed description of the imago, following which are tables, supported by line figures, chiefly of wings and genitalia, for the separation of families, genera, and species. Six pages are devoted to the description of the egg masses of some families, genera, and species, and there follows a detailed description of the larva and tables for separating larvæ into their respective families, genera, and species. Lastly the pupa is described, and another series of tables enables the worker to identify the family or subfamily to which a pupa belongs, and he may then complete the identification either by reference to the genitalia of the imago (if they are already formed beneath the pupal cuticle) or to the larval cuticle. These excellent systematic accounts o. the larvæ and pupæ, which occupy 112 pages, are alone sufficient to secure for the volume a hearty reception and commendation.

The volumes on the other orders of insects (Hefte vii., viii., and ix.) are on a plan similar to that of the two volumes above noticed, as also are the accounts of the Crustacea. For instance, the Phyllopoda (Heft x.) are divided into Euphyllopoda and Cladocera, each section being in turn subdivided into families, genera, and species, separate tables being given, where necessary, of the characters of male and female specimens. Two hundred and sixty-five outline drawings of the carapace, terminal hooks, setæ, antennæ, &c., make clear the references to these characters in the text.

The account of the Trematodes (Heft xvii.) is admirably arranged and complete. Tables giving the characters of the adult, and in some cases also of immature forms, are provided. There are lists of the Trematodes which have been found encysted in those birds, Amphibia, fishes, molluscs, and arthropods which are associated with fresh water, and there is a useful appendix on cercariæ. The utility of the volume would be increased if a "host-index" were added, by means of which the worker could ascertain what parasites had been recorded from the particular host which he happens, at the moment, to be examining.

The numerous figures, many of them original, which illustrate these volumes are of exactly the kind to elucidate the text; only very rarely is a defective figure met with; here and there a shaded drawing has become rather too dark in the course of reproduction, thus causing part of its detail to be obscured. The generic and specific names adopted are thoroughly up to date. Synonyms are given in only a comparatively few cases, such as those in which a well-known name has been recently superseded; a few more cases would have been the better for similar treatment; for instance, such well-known names as Paludina and Cyclas might have been given as synonyms under Viviparus and Sphærium resp tively. One regrets the disappearance of many well-established names, *e.g.* Apus is replaced by Triops, and the alteration of others, *e.g.* Daphnia to Daphne, Anodonta to Anodontites, Artemia to Artemisia; these changes in zoological nomenclature seem to be almost endless, and sometimes, as in the last-named case, to be of doubtful value.

The volumes are of handy size, about 8 inches by 4½ inches, suitable for the pocket; they are printed on thin paper, so that the largest (on the Trichoptera, 326 pp.) is only half an inch in thickness.

So considerable a proportion of the fresh-water fauna of Britain is found also in Germany that the student of the British fresh-water fauna may turn to these volumes with the assurance that, in most cases, he will find there the information he requires to enable him to identify his material. These excellent volumes are certain to prove of the greatest service to workers on the fresh-water fauna, not only of Germany, but of a wider area.

CRETAN ARCHÆOLOGY.

Crete, the Forerunner of Greece. By C. H. Hawes and Harriet Boyd Hawes. With a preface by Arthur J. Evans. Harper's Library of Living Thought. Pp. xiv+158. (London: Harper Bros., 1909.) Price 2*s*. 6*d*. net.

MRS. HARRIET BOYD HAWES, better known to us, perhaps, under her maiden name of Miss Harriet Boyd, and her husband, Mr. C. H. Hawes, have written a very useful little book which may be described as a short, popular description of the antiquities of Crete which have been discovered during the last ten years by Dr. Evans, Prof. Halbherr, and by the distinguished author herself. More popular than Prof. Burrows's admirable "Discoveries in Crete" (though, at the same time, in no way less useful to archæologists), and published at half the price of even his book, "Crete, the Forerunner of Greece," should bring the interest and the importance of the Cretan discoveries home to the minds of all. Mr. and Mrs. Hawes have rightly insisted on the fact that the Cretan discoveries should in reality interest us more than similar discoveries in Assyria, or Palestine, or even in Egypt, because the Cretan civilisation of the Bronze age was the forerunner and the ancestor of that Hellenic culture which is ours today. In spite of the dark age of mediævalism in Europe, the tradition of Græco-Roman civilisation survived, and we have now returned to it. Greek culture was but a revival, after an analogous dark age of mediævalism, of the great civilisation of the Ægean Bronze age, younger sister, probably, of the ancient culture of the Nile valley. Our civilisation goes back in Greece to the very beginning of things, almost to

the remote epoch when it diverged from the Nilotic culture, and Mr. and Mrs. Hawes's little book is designed to instruct those who wish to know the story of its origins. *Felix qui potuit rerum cognoscere causas.* Religious ideas have largely directed the general interest in our origins towards the "Bible-lands," whence sprang the exotic oriental religious element in our culture, but the growth of knowledge and of civilisation is steadily weaning us from our Semitic and mediæval foster-parents, and interesting us more and more in Greece and Rome, the real parents of our minds and thoughts; and the origin of Greece and of Rome was Crete, and Crete may have sprung from the same common source as Egypt.

Of the Egyptian inspiration which we see in the early art of Crete the authors of this little book say little. They have no space in which to discuss disputed points, and their personal bias is, perhaps, rather away from any even so-called "oriental" influences (we do not admit, by the way, that Egypt was ever "oriental" in the sense that the Semitic world was and is). They merely describe what has been found in Crete and is to be seen there, either in the ruined palaces of Knossos and Phaistos, or in the towns of Gourniâ and Palaikastro, or in the museum of Candia, where the treasures found in the course of the excavations of these places are preserved. They conclude with a chapter on Cretan (Minoan) art which strikes us as very correctly appreciative of the peculiar genius of the earliest European artists, so unequal in quality, so good, so magnificent in conception and workmanship at times, at others so weak; yet honest and free, unshackled by any of the conventions that bound the artists of Egypt and Assyria (who, but for these conventions, would have done as well as the Minoans), and the worthy ancestors and forerunners of the artistic genius of Hellas. On this we must always insist; the Minoan art of Greece *was* the ancestor of that of the Hellenes, who inherited their artistic genius, not from the Indo-European Greek-speaking northern originators of half their blood, but from their other ancestors, the ruddy non-Aryan Mediterraneans, brothers of the Egyptian and of the Etruscan. It is from these, albeit we ourselves in the north have little or none of their blood in our veins, that we have derived most of what makes us civilised beings.

PRACTICAL CURVE TRACING.

Practical Curve Tracing, with Chapters on Differentiation and Integration. By R. Howard Duncan. Pp. vii+137. (London: Longmans, Green and Co., 1910.) Price 5s. net.

THE methods employed in this book, which presents an attractive appearance, are almost entirely independent of the aid of general mathematical principles. For instance, the form of the graph of $y=ax+b$ and its dependence on a, b are explained by plotting graphs of the equations obtained by varying a while b remains constant, and then those obtained by varying b while a remains constant. Naturally greater difficulties occur in handling the equations $y=ax^2+bx+c$, $y=ax^3+bx+c$, &c., by the same method. Inexpert mathematical students of the type for whom the author writes find it very hard to get hold of the notion of a parameter, and a great deal could certainly be done by adopting the plan indicated above, and steadily followed in this book. Even the ordinary student of analytical geometry would probably get at "the facts of the case" sooner if he approached, for example, the equation $x^2+y^2-ax-b=0$ by drawing graphs of the circles of the specified system, keeping b a positive constant and giving a various values, then keeping b a negative constant and varying a.

It is this positive and distinct advantage that is emphasised by the author, and from this point of view are discussed the parabolic, hyperbolic, exponential, and logarithmic curves, together with the sine curve, of the natures of which a good account is given. For students of graphs who have at their disposal algebraic machinery up to division and quadratic equations, the road to a knowledge of the forms of many graphs could be made shorter. The artifices of change of origin and scale-unit, even without those of successive approximation, do not offer a great difficulty to a student of small mathematical ability, and go a long way towards establishing the rough form of the graph of an equation which would appear alarming if it had to be discussed by the plotting of points.

Two chapters on the calculus are added to those on curve tracing. The author knows that "the method of measuring the slope of a curve by actually drawing the tangent is sometimes objected to on the ground of inaccuracy"; but his experience "shows that by good and careful workmanship it is possible to rely on the results so obtained to a degree of accuracy which is sufficient for practical purposes." Yet the degree of accuracy indicated in some of the results tabulated in the chapter on differentiation must be very difficult to attain. Indeed, curves of $y=x^2$, $y=x^3$, &c., are constructed, tangents are actually drawn, dy/dx and x are tabulated and then plotted against one another directly or logarithmically, with so much accuracy that the rules for the differentiation of x_n, e^x, $\log x$, $\sin x$, $\cos x$, are deduced. The reader certainly will have it very definitely impressed upon him that dy/dx measures the slope of a curve. Of course, there remains the difficulty for an engineer, or any other who applies the calculus, of being able to identify the slope with the rate of variation of the corresponding function, and of appreciating the very varied significance of the derivative in its applications; but the book does not profess to enter on this field.

A few examples on each chapter are gathered together at the end of the volume, the purpose of which is evidently that the reader should be clear regarding the facts at the base of the equations and functions discussed before he sets out to equip himself in the practice and applications of the methods explained.

P. P.

AN ALTERNATIVE TO QUALITATIVE ANALYSIS.

Introduction to Experimental Inorganic Chemistry. By H. Biltz. Translated by William T. Hall and J. W. Phelan. Pp. vi+185. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1909.)

THIS book is intended to supply the lack of knowledge of descriptive chemistry which has resulted from the omission of "test-tube work" from the curricula of the schools or its restriction to small classes of advanced scholars. As compared with the "qualitative analysis" which it is intended to precede or to replace, as the case may be, the course now suggested has certain obvious advantages, arising more especially from the fact that the experiments are designed directly for the purpose of supplying a knowledge of the elements and their compounds, instead of serving this purpose only indirectly through the medium of a scheme of work designed originally for an entirely different purpose.

The abuse of the older method, by which a student could be trained to "get out" his salts and pass his examinations without acquiring any adequate knowledge of the processes used in doing this, is well known, but the alternative scheme now suggested is by no means free from faults. One of the most serious accusations that may be levelled against it arises from its monotony. Thus, in dealing with the metals, the student is expected to examine one metal after another, to heat it, dissolve it in acids, and then try the effect of a series of different agents on its solutions. After this has been done for a dozen different metals the student would certainly complain of weariness, and it is doubtful whether his mental faculties would be kept sufficiently on the alert to produce any permanent impression at the end of his course. The loss of the interest which is supplied in qualitative analysis by the incessant stimulus of a problem to be solved is a very serious drawback, and the course which the authors present would need very careful handling to prevent the class from going to sleep over its work or gliding through it without effort and, therefore, without profit.

The best use to which the book could be put would be as a duplicate text-book for a student engaged on qualitative analysis, so that when presented with a new element he might, whilst learning how to detect it, acquire at the same time some systematic experimental knowledge of its properties. If blended in this way with a series of problems, the experiments now described would undoubtedly be of considerable value.

The most noticeable fault in the arrangement of the book is due to an uncertainty on the part of the authors as to whether they are giving instructions for, or supplying a descriptive account of, the experiments. This confusion has resulted in a compromise whereby one experiment is described in the imperative tense and the next as a narrative in the present tense. It is also a characteristic weakness of the scheme that formulæ and equations are given without any hint as to the quantitative experiments on which they must necessarily be based. This lack might doubtless be corrected by a teacher who was aware of the danger that the class might look upon a formula or an equation as an inspired product, to be accepted as a revelation sent down to mankind through the prophetic agency of the writers of text-books; but a course of chemistry which leads off with the words, "Hydrochloric acid, HCl, is a colourless gas. . . ." would (if left to develop its natural effects) be admirably calculated to propagate this all too prevalent heresy.

T. M. L.

THE WELFARE OF WOMEN.

The Health of the Nations. Compiled from Special Reports of the National Councils of Women. Pp. 191. (London: Constable and Co., Ltd., 1910.) Price 1*s.* net.

THE International Council of Women, of which the Countess of Aberdeen is president, was formed in 1888 by "a company of earnest American women" (p. 7). The result of their efforts was a federation of national councils, or unions, or associations, of women working for the common welfare. Mrs. Ogilvie Gordon sketches in this small volume the history of the council, noting the resolutions of its quinquennial meetings in the various countries, and summarising, for the year 1909, certain "special reports" prepared by representative women in Europe, America, and other continents. The movement is ambitious, and it is almost needless to say that the "special reports" here collated are of the most generalised kind. In a brief 200 pages of well-leaded print, it is not possible to give a passable summary of the "health" even of one nation, not to speak of the twenty-one "nations," or countries, here dealt with. But it is gratifying to find some twenty-two national councils of women (p. 12) sufficiently interested in general hygiene to produce even these somewhat sketchy "reports."

The main point is that the nations are thus showing an increasing concern for one another, and the International Council of Women, in focussing attention on the leading features of public-health progress, is doing, *pro tanto,* a real international service. Such reports are intended to excite interest rather than to provide materials for scientific conclusions, and, from this point of view, there is much to be said for them.

It is, however, to be regretted that there is so little reference in detail to extant official or other trustworthy documents. Had the papers each been supplemented by a short list of definite references, the usefulness of the little volume would have been immeasurably increased. As it is, one has difficulty in taking the statements on trust. For instance, in a "report on public health" for the "countries" of "Great Britain and Ireland," one finds it said—and the date of the "preface" is 1909—that "there is no compulsory notification of tuberculosis in Great Britain, but voluntary notification, instituted by local authorities, obtains in many places" (p. 65). Yet at that date, May, 1909, nearly 25 per cent. of the population of Scotland was under "compulsory notification," a fact that could have been obtained without difficulty, either from published blue-books or from

application to the Local Government Board for Scotland. Incidentally, it may be said that the percentage now probably approaches 50; yet a volume on "The Health of the Nations," issued in 1910, contains no clue even to the fact that Scotland is a separate administrative area of Great Britain.

This kind of report is not reassuring as to the other countries; but doubtless the various correspondents will be able to put inquirers "on the track" of more definite information. The work of collation is well done by Mrs. Ogilvie Gordon, and the volume forms a good intellectual point of repair for the many women everywhere concerned to consider and improve the life and labour conditions of women.

PROGRESS OF CHEMICAL AND PHYSICAL SCIENCE.

Fortschritte der Chemie, Physik, und physikalischen Chemie. Neue Folge des Physikalisch-chemischen Centralblattes. Vol. I., 1909. Edited by Dr. Hermann Grossmann and others. Pp. 386. (Leipzig: Gebrüder Borntraeger; London: Williams and Norgate, 1909.) Price 16 marks.

THIS work on the progress of chemistry, physics, and physical chemistry, which represents the first annual volume of a new series of the "Physikalisch-chemische Centralblatt," is issued in monthly parts, and contains a number of interesting reports by specialists on various branches of chemistry and physics, the period under review being 1908 and a portion of 1909.

Two articles on radio-activity and electronics indicate the interest attached to these rapidly developing branches of science, and it is gratifying to find that a substantial part of the pioneering work in this section results from the labours of British chemists and physicists.

The important subjects of spectroscopy, catalysis, thermochemistry, chemical equilibrium, velocity of reaction, and the theory of gases are dealt with in special reports. Recent observations on the influence of light on chemical change are summarised in the article "Photochemistry," by A. Byk.

The study of colloids is a branch of general chemistry now making rapid advances, and the researches of 1908 in this field are discussed by A. Müller, who also deals with the practical application of these investigations to the technical process of dyeing, tanning, photography, and biological chemistry.

The editor, Dr. H. Grossmann, contributes a memoir on complex chemical compounds, in which he reviews the work done in this branch of chemistry during the first half of the year 1909. He groups these so-called "molecular compounds" under four headings:—(1) Compounds with complex cations; (2) compounds with complex anions; (3) auto-complex compounds; and (4) organic-inorganic complex compounds.

One of the most interesting articles in this volume is that on the incandescent mantle industry, written by C. R. Böhm, who describes the rise and development of this important branch of manufacture, and gives a brief outline of the processes involved in the production of Welsbach mantles on a commercial scale.

The report on pharmaceutical chemistry is noteworthy because it includes a description of the synthesis of racemic suprarenine by Stolz and Flächer. The latter chemist has since separated this product into its two optical antipodes. The lævorotatory base is identical with the active base of the suprarenal capsules, and, when introduced into animals by intravenous injection, produces a very marked increase in the blood pressure. The dextrorotatory suprarenine, under similar conditions, is practically inoperative.

In addition to the above mentioned monographs, the volume contains reports on the recent development of chemical science under the various headings of physical, inorganic, organic, analytical, physiological, and agricultural chemistry. These summaries contain the same information, and discuss topics similar to those dealt with in the annual reports on the progress of chemistry published in recent years by the Chemical Society, and are therefore hardly likely to be preferred by the English reader.

OUR BOOK SHELF.

Radium. By J. P. Lord. Third edition. Pp. x+103. (London: Harding, Bros. and Co., 1910.) Price 2*s.* 6*d.* net.

THIS book, to quote from the preface, consists "of a careful compilation of the more material facts needed for an elementary understanding of radio-active phenomena, especially in relation to therapeutic and kindred progress," and the author's aim has been "to steer a middle course between the popular and the scientific literature of the subject, avoiding over-technicality, on the one hand, and on the other, that looseness of which the popular treatment of a scientific matter is peculiarly susceptible." On the whole the book seems fairly well fitted to fulfil its object. The author has successfully avoided over-technicality, but has not been entirely successful in retaining accuracy. In discussing the energy of radium, the view appears to be taken that because the radiations escaping are limited to a thin layer beneath the surface, the heat generated is also limited by the thickness of the layer. The commercially important ratio of radium to uranium in minerals is given as 700 milligrams of the former per ton of the latter, which is more than twice as great as the actual ratio. The present commercial price of radium is given as slightly more than 1000*l.* per grain, which is particularly unfortunate in such a book, since small quantities can be bought at the present time at about one-quarter or one-fifth this rate.

The chief interest of the book is the description and photographs given of certain new mines of autunite (hydrated uranium calcium phosphate) near Guarda, in Portugal, in the exploitation of which the publishers of the book apparently are interested. The deposits are described as occurring in lodes, varying from an inch to three or four feet in thickness, containing the uranium ore in crystals. A set of radiographs taken with the new material, of percentage of uranoso-uranic oxide varying from 39 to 1·5, is included, together with some plates of instruments commonly employed in the measurement of radio-activity. The last three chapters are devoted to the medical uses of radium, on the present state of which the author appears well informed.

Artrópodos Parásitos. By Prof. Daniel Greenway. Con prologo del Prof. Dr. Pedro Lacavera. Pp. viii+230. (Buenos Aires: La Ciencia tredica, 1908.)

THIS work, issued in 1908, is mainly a compiled account of some of the various Arthropoda that attack and annoy man and animals, or which are parasites or carry diseases. It commences with a description of the Linguatulidæ and Demodecidæ. Then follows an account of the Sarcoptidæ, especially dealing with the human itch mite (*Sarcoptes scabiei*). Several species of Tyroglyphidæ are figured, and also other mites. Information concerning the Ixodidæ, or ticks, covers twenty-one pages, and two useful tables of the genera are given. The piroplasma-carrying *Boophilus bovis* is shown on three coloured plates in adult male and female and larval stages.

Some poisonous spiders are referred to and figured, including the large *Mygala avicularia*. The insects take up most of the volume, extending from p. 89 to p. 221. After a general account of the Hexapods, the author commences with the parasitic and blood-sucking Hemiptera, dealing almost exclusively with the Pediculi.

The major part of this section concerns the Diptera, including the aphaniptera, or fleas. A good account of the "Jigger" (*Sarcopsylla penetrans*) is given.

This is followed by a description of the tsetse-flies, or Glossinæ, including a table of species, ten being tabulated, including *G. bocagei* (G. Franca, 1902). Notes are also given on the screw worm (*Compsomyia macellaria*), Dermatobia, and other Œstridæ. A considerable space is devoted to a general outline of the family Culicidæ, with a coloured plate reproduced mainly from Arribalzaga's "Diptera Argentina." The central figure (No. 4) of *Anopheles claviger* (*maculipennis*) is scarcely recognisable.

Some misprints may be noticed, such as *eolopus* for *calopus* (Fig. 149), *bobis* for *bovis* (p. 181), &c.

F. V. T.

Der Kampf um Kernfragen der Entwicklungs- und Vererbungslehre. By Oscar Hertwig. Pp. iv+122. (Jena: G. Fischer, 1909.) Price 3 marks.

WITH his usual clearness, Prof. Oscar Hertwig sums up the situation as regards the *rôle* of the nucleus in heredity. After stating the foundations of fact on which theories of heredity and development must be built, he enters upon a careful discussion of the important question whether the nucleus is the sole vehicle of heritable qualities. As Fick puts it, Has the nucleus a "Vererbungsmonopol"? The author defends against all-comers the "Hertwig-Strasburger (1884) hypothesis of the localisation of the idioplasm in the nuclear substances," and his arguments are put with much force. They are seven in all, the three best being the equivalence of ovum and spermatozoon as regards nuclear material, the precise partition of nuclear substance in karyokinesis, and the reduction which obviates an accumulation of nuclear material. The case is argued with fairness, and the difficulties which abound are considered carefully, the general conclusion being that the 1884 hypothesis is consistent with a large series of important facts, and that no well-established fact is inconsistent with it.

There is much interesting discussion in the volume, which is conspicuously lucid throughout. We should also refer here to the revised and enlarged edition (Jena: Fischer, pp. 46) of a lecture which Hertwig gave in 1900 on the development of biology in the nineteenth century. It is interesting to notice from the additions that the author is of opinion that actual advances in knowledge necessitate a re-consideration of the theory of natural selection, the Lamarckian theory of direct adaptation, and the recapitulation doctrine.

(1) *Man in Many Lands: Being an Introduction to the Study of Geographic Control.* By Prof. L. W. Lyde. Pp. vii+184. (London: A. and C. Black, 1910.) Price 2*s.* 6*d.*

(2) *Questions on Herbertson's Senior Geography.* By F. M. Kirk. Statistical Appendix by E. G. R. Taylor. Pp. 64. (Oxford: Clarendon Press, 1910.) Price 1*s.*

(3) *Experimental Geography.* By G. C. Dingwall. Pp. vii+168. (London: George Bell and Sons, 1910.) Price 2*s.* 6*d.*

(4) *Cambridge County Geographies. Cornwall.* By S. Baring-Gould. Pp. ix+164. (Cambridge: University Press, 1910.) Price 1*s.* 6*d.*

THOUGH all are intended to assist school pupils to learn geography, these books have very little in common, so far as the methods adopted by the various writers are concerned. The books show vividly the present diversity of opinion as to the best way of teaching geography. The teacher has a difficult task just now in deciding the course his lessons should take, for the examining and inspecting authorities he has perforce to serve are not yet agreed among themselves. Fortunately, there is a growing conviction that the best results are obtained only when the pupils participate actively in the lessons; and the plan is becoming more and more common of setting children to work for themselves exercises designed to bring out some important principle or fact. The second and third of the volumes under notice will assist the teacher in this part of his work; the third especially, though it follows lines which have been laid down by previous books, will indicate ways in which the pupil may be taught to make his own text-book.

Prof. Lyde maintains his reputation as an experienced teacher. His book is an excellent example of the way in which the practical teacher can make geography a valuable instrument for training boys and girls to reason intelligently. The well-selected coloured illustrations add greatly to the attractiveness of the book.

The last volume is well up to the high standard of the series to which it belongs.

Highways and Byways in Buckinghamshire. By Clement Shorter. With illustrations by F. L. Griggs. Pp. xix+344. (London: Macmillan and Co., Ltd., 1910.) Price 6*s.*

A COUNTY or a country may be described from various points of view, and in each case the things seen will depend upon the temperament or sympathies of the observer. In this addition to an admirable series of guide-books, the predominant view is that of prominent persons connected with a county which is rich in historic interest. Of the natural history or geography of the county there is nothing, but the human side, which appeals to a wider circle of readers, is presented in a style that commands attention. A few lines are given to Sir William Herschel in connection with Slough, and mention is made of Sir Kenelm Digby, who first brought Sir Thomas Browne's "Religio Medici" into notice, but little more is said of the association of science with the county. Perhaps the mention of Hester Sandys, who married Sir Thomas Temple, of Stowe, and lived to see seven hundred descendants from the union, will interest biologists. Mr. Shorter acknowledges that he is concerned only with the personal element of Buckinghamshire; so while we may regret the limitations thus imposed upon the county's attractions, it would be unjust to apply to his attractive volume any other standards than those of biography and history. There is no lack of living interest, and the volume is sure to be read widely both within and without the county.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Meteorological Observations during the Passage of the Earth through the Tail of Halley's Comet.

I HAVE cursorily examined the records from ten registering balloons sent up from Ditcham Park and Pyrton Hill on May 18, 19, and 20. Nearly all the traces show large fluctuations of temperature; but such fluctuations have been observed before, and there is nothing that leads me to suppose that the passage of the earth through the tail of the comet, if, indeed, it occurred before 7 a.m. on May 20, had any effect on the temperature of the upper air. Five of the balloons reached 17 km. or more, and all exceeded 13 km. W. H. DINES.

June 6.

THE quantity of ozone in the atmosphere at great altitudes, which for some time has been the subject of an investigation by the writer, was estimated on May 18 and 19. It was thought that, in this way, some light might be thrown on the question as to whether any electrical discharges of any magnitude took place in the higher atmosphere during the transit.

The method of conducting these measurements is described in the Transactions of the Chemical Society (1910, xcvii., 868), and consists in the use of a concentrated solution of potassium iodide. It has been found in this work that very dilute ozone reacts with potassium iodide to give iodine, potassium hydroxide, and potassium iodate, the relative amounts of each varying with the temperature. This reaction enables a distinction to be made from oxides of nitrogen, which only give free iodine, and from dilute hydrogen peroxide, which gives iodine and potassium hydroxide, but no iodate.

Three successful experiments were made with the help of the meteorological balloons at about the time of the transit, and the following results were obtained:—

Time of ascent of balloon	Height attained	Amount of ozone per cubic metre air
	km.	mgrm.
May 18, 9.40 p.m. ...	17 ...	0·51 (or 1 part in about $2·6 \times 10^6$)
,, 19, 2.10 a.m. ...	12 ...	0·54 (,, ,, $2·4 \times 10^6$)
,, 19, 6.30 a.m. ...	20 ...	0·43 (,, ,, $3·0 \times 10^6$)

The above quantities of ozone are not materially different from the amount usually present in the air at these altitudes. Thus the average of three measurements made on March 18 corresponds to 0·72 mgrm. ozone per cubic metre air.

There was also no appreciable change in the quantity of oxides of nitrogen. J. N. PRING.

Physical Laboratory, Manchester University.

Ooze and Irrigation.

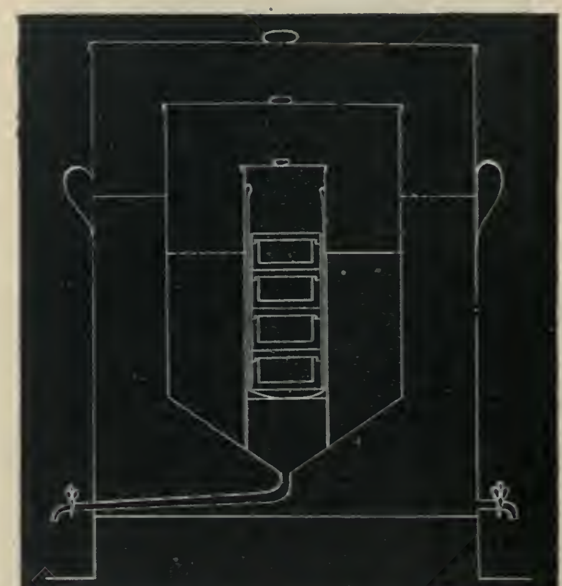
AGES have passed since the cultivator first realised the value of rivers as agents in fertilising the soil. The Nile is the classical illustration, and everyone has learned in early life to think of Egypt as being dependent on the life-giving waters for its fertility. But have the reasons for that ever been sufficiently investigated? Probably the majority of people would say that the waters of the Nile bring down vast quantities of soil and disintegrated rock from the heart of Africa, and this earthy matter, held in suspension or carried down by the river in spate, contains the chemical elements which are essential to the growth of plants. I believe that is the usually accepted theory; but does it go to the root of things? Others find the secret in the action of bacteria. I grant the point, but do not think it fully accounts for the facts. I have for some years been engaged in the study of our fresh-water annelids and their place in the economy of nature. I had occasion a few days ago to bring home from the banks of one of our Midland rivers some of the ooze from its banks. When I collected it I found some half-dozen specimens of a common fresh-water worm wriggling about in the slimy mass; but when I came to examine it at leisure, with pocket lens and microscope, I found it to be teeming with life. Vast numbers of tiny annelids (*Tubifex templetoni*, Southern, or an allied species), minute larvæ, and other living things were to be seen, and at once the question arose, Would the ooze, detritus, alluvium, or disintegrated rock of itself be so special a fertiliser if this teeming life were absent? The ooze is enriched both by the passing of the matter through the bodies of the animals and by the nitrogen from their corpses.

It seems to me that there is need for careful study of the alluvium of rivers from this point of view. Life has probably much more to do with the soil of the Nile and other rivers than is generally suspected. It would be a profitable thing for students to examine the mud of rivers like the Nile during the different seasons. It would then probably be found that at low water various annelids and other aquatic life-forms were breeding rapidly. The myriads of young would be carried by the flood into the lands which are irrigated by the river, and here they would not only be the food supply for the larger forms of life, but would help to keep the soil from becoming sour, and supply vast stores of nitrogen for the plants. I should be happy to hear from workers in this field, and give any hints which experience has taught me.

Gt. Malvern. HILDERIC FRIEND.

On the Preservation of Hailstones and the Investigation of their Microstructure.

THE investigation of the microstructure of hailstones in summer having proved very difficult, if not impossible, I constructed an apparatus (Fig. 1) for their preservation



FIG

until winter time. The apparatus consists of three co-axial cylinders; the inner space is intended for hail; the middle space for a mixture of ice and cupric sulphate (approximately in the proportion corresponding to eutectics $t = -1·6°$); the outer space for ice, forming a sort of guard coat.

During the summers of 1908 and 1909 I had only once the opportunity of observing a hailstorm; this was on August 2/15, 1909, when I was at sea near Helsingfors on my way from Åland to St. Petersburg. This hail lasted three to four minutes; the hailstones were very small (2–3 mm. diameter), but I gathered 200–300 grams of them, and, in order to avoid their freezing together, immersed them in glass boxes with a mixture of nearly equal parts of benzol and toluol, which I presumed to be of a density equal to the density of hailstones, but which proved to be lighter. These hailstones I brought later to Tomsk (Siberia), and in December sent them to the twelfth Congress of Russian Naturalists and Physicians in session at Moscow. These facts demonstrate thoroughly the possibility of the preservation and transport of hailstones. My

experiment has also shown that it would be better to preserve one or two hundred hailstones separate from each other than a greater number of them, but partly—especially in lower layers—frozen together. That can be attained by placing the hailstones in some very viscous liquid (*e.g.* cylinder-oil, vaseline, or castor-oil) of a density nearly equal to that of hail.

For the investigation of the microstructure of a separate hailstone Mr. W. Dudecki and I made a thin section of it by first rubbing one side on emery-paper or by melting it with the warmth of a finger. This side was laid upon an object-glass and frozen to it, after touching for some time with a finger the other side of the glass. The other side of the hailstone was then polished in the same manner as the first until the requisite thickness was attained. These operations were made in free air, and were so much easier, as the temperature of the air was below 0°. Still, it was found possible to grind hailstones in the laboratory at the temperature of the room by means of cooling the object-glass, the emery-paper, &c., in double-walled vessels with a mixture of ice and common salt.

For the optical investigation of thin sections in free air a polarising microscope was used, and in a lecture-room a projecting lantern. In the latter case (Fig. 2) the section

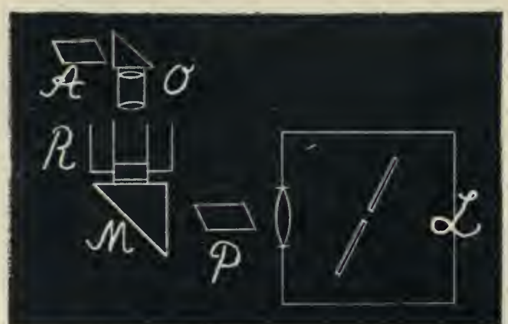


FIG. 2.—L, Projecting lantern; P, polariser; M, mirror; R, refrigerating vessel; O, objective; A, analyser.

was laid in a refrigerating vessel with double walls and double bottom (to avoid the condensation of aqueous vapour from the surrounding air) of plane-parallel glass plates. The space between the walls contained a mixture of ice and common salt. The real image of the section was thrown on a screen or on a photographic ("Autochrom") plate.

The greater part of the hailstones were crystalline individuals, as also was the case with "artificial hailstones"—drops of water frozen in a mixture of cinnamon and linseed oil of suitable density. In those hailstones, which consisted of several crystalline individuals, there was no regularity in the form of the boundaries between crystals, or in the angles between these boundaries, or in the directions of the optical axes, which lay indifferently to each other, as well as to the milky nucleus of the hailstone, which appeared in the section as a number of air-bubbles of different size.

I trust that my attempt will cause similar researches to be undertaken, and I should be very glad if anyone who may be able to preserve or study larger or more peculiar hailstones than I have hitherto done will do so, and in this way improve our deficient knowledge on the origin of hail and the details of its formation. BORIS WEINBERG.

The Physical Laboratory of the Technological Institute of Tomsk, Russia.

Thoughtless Destruction of Wild Flowers.

MAY I ask through your widely circulated paper that those who organise the weekly or fortnightly visits of poor town children to country villages may be requested to instruct these children to pluck only a limited number of wild flowers? It is no uncommon sight to see a dozen or more of these children going along a road or railway embankment and plucking every flower they can find, as well as rooting up those which are small enough. In half an hour the flowers have withered, and are thrown away, when the same process is repeated. GEO. HENDERSON.

Otford, Kent, May 27.

RECENT PROGRESS IN INDIAN FOREST TECHNOLOGY.

THE excellence of the work of any public department depends on the character and ability of the men who direct it, and the Indian Forest Department was singularly fortunate in its first Inspector-General, the late Sir Dietrich Brandis, K.C.I.E., F.R.S. He secured State ownership and State management for the forests both in British India and in the native States, and also a trained staff of forest officers. He placed Indian forest law on a firm basis by selecting as Conservator of Forests, Mr. B. H. Baden-Powell, C.S.I., a member of the Punjab Civil Service, who, after working for a decade of his life in the forest service, became presiding judge of the chief court at Lahore. Baden-Powell drafted the Indian Forest Acts, models of forest law that are followed by all colonial legislators, and his "Manual of Forest Jurisprudence" is the only English book on the subject. No mere forester could have drafted those laws successfully, nor could any mere lawyer, but Baden-Powell was both lawyer and forester.

Brandis also established a forest survey under Lieut.-Colonel F. Bailey, R.E., and Mr. W. H. Reynolds, and their maps gained gold medals at two Paris exhibitions, and were the first Indian maps that showed a good system of contour lines. A forest school for training native members of the provincial and executive staffs of the Forest Department was established in 1881, at Dehra Dun. Useful manuals of forestry, by Mr. E. E. Fernandez, and of botany, were published soon after the establishment of this school for the use of the students. Brandis also published a Forest Flora of Northern India, followed quite recently by his last great work, "Indian Trees," a forest flora for the whole of India. Mr. Kurz had previously written one for Burma and Major Beddome for Madras, while Mr. J. S. Gamble, C.I.E., F.R.S., published a splendid monograph of Indian bamboos. Gamble, under Brandis's direction, published, in 1881, a "Manual of Indian Timbers," and again, in 1901, after collecting material for twenty years, a new and greatly enlarged and improved edition. "The Indian Forester" first appeared in 1876, Dr. Schlich, now Sir W. Schlich, K.C.I.E., F.R.S., being the first editor. Schlich succeeded Brandis as Inspector-General of Forests in 1881, and instituted a proper system of working plans for Indian forests. He came home in 1885 and established a school of forestry at Coopers Hill, and, in conjunction with myself, published a "Manual of Forestry."

The training of men in England for the Indian Forest Service was not at first in accordance with the wishes of Brandis and Schlich. They recommended that the Imperial School of Forestry should be at an English university, and that, as the so-called Civil Service of India is recruited chiefly from university men of good literary and legal attainments, so the Imperial Forest branch of the Civil Service, which manages one-quarter of the land of British India, should be composed of university men of good scientific attainments. But the India Office wished to support the Royal Indian Engineering College at Coopers Hill and kept the forest probationers there until 1905, the year before the college was closed. In 1905, an Imperial School of Forestry was established at Oxford under Sir William Schlich, and is now training more than seventy men for India, the colonies and for forest work at home.

Until 1904 very little progress was made in Indian forest technology, for which Brandis had laid such

splendid foundation. It was found that the class of candidates for the forest service was falling off in numbers and quality, the salaries were not sufficiently attractive, and in 1905 only two candidates appeared for sixteen posts, so that a system of appointment by selection was adopted. The Secretary of State has now raised the pay of the Indian Forest Service, and allows 120*l.* a year to such of the two years' probationers who are B.A.s with honours from any university, so that this year there were sixty candidates for twelve appointments. Besides insisting on the qualification of an honour degree, it is essential to secure that all probationers should join the Oxford School of Forestry, with a sufficient knowledge of English, elementary mathematics (including trigonometry), physics, and chemistry. During the two years' course for a forestry diploma at Oxford, botany, zoology, and geology can be taught, as well as forestry, surveying, and forest law. Strange to say, some of our British universities have such an imperfect entrance examination that men are allowed to enter for and take honour degrees in biology or geology without necessarily knowing more than the rudiments of mathematics, chemistry, or physics, and without passing any test in English. The possession of an honour degree in science at a British university is not, therefore, a sufficient qualification for a forest probationer. A certain knowledge of German also is very desirable for admission to the Oxford School of Forestry, and this is but rarely obtainable from our public-school men. Our best Oxford foresters should be capable of teaching scientific and practical forestry throughout the Empire.

Although the forests of India, between 1885 and 1905, continued to be well managed by a devoted corps of practical foresters, very little, if any, progress in forest technology was made during those twenty years. In 1906, Mr. S. Eardley Wilmot, C.I.E., Inspector-General of Forests, following the initiative of his predecessor, Mr. R. C. Wroughton, established a forest research institute the members of which devote all their time to the study of the various branches of forestry, as well as to zoology, mycology, and the physics and chemistry of forest products. The results of this research are published in "Indian Forest Records." Vol. i., for 1909, of these records contains papers on the lac insect, by E. P. Stebbing; on beetles boring in Chilgoza bark, by E. P. Stebbing and Capt. E. H. James; the development of *Shorea robusta* in volume and money value, and the selection system in Indian forests, by A. M. F. Caccia; Andaman Padank, by B. B. Osmaston; the Cutch trade of Burma, by R. S. Troup; Ngai camphor, and Burmese varnish from the sap of *Melanorrhoea usitata*, by Puran Singh. Several useful and, for the most part, elementary manuals have been prepared by members of the Research Institute and others, the most elaborate of which are "Indian Forest Engineering," by G. M. Rogers, and "Indian Forest Zoology," by E. P. Stebbing.

Unfortunately, the establishment of this institute was followed by a temporary deterioration of the teaching staff in Dehra Dun, for the Government of India did not accept Mr. Wilmot's proposal to retain an adequate staff of instructors there, but handed over the practical teaching to the provincial staff, the research officers considering that their other duties would not allow them time to teach the students. The Dehra Dun Forest School, recently dignified with the title of Imperial Forest College, was overcrowded with students, 120 applications for admission having been received in 1909, and the students had not sufficient respect for their native teachers, so that discipline suffered greatly.

The Indian Universities Act of 1894, which has exerted its influence so widely on higher studies, has failed to reach Dehra. Engineering, medicine, and agriculture, and science generally, have made great advances of late in response to the stimulus of university reform, but at the Imperial Forest College the qualifying entrance examination is still much the same as when it was a school, and its courses still include an amount of rudimentary science that should have no place at a college. This becomes evident when the standards there are compared with those at the agricultural colleges recently established in the various provinces of India. The final examination for the diploma in forestry at Dehra should also be equivalent to those for a B.A. degree, as is the case at agricultural colleges.

The present Inspector-General of Forests, Mr. F. Beadon Bryant, has recognised that the teaching of forest rangers has fallen off since the Research Institute was started, and that it was a mistake to entrust the teaching of classes of sixty students there to members of the provincial service. Research officers in future will give lectures to the students during the four months' monsoon session, and three officers of the Imperial Forest Service are being appointed to teach the students throughout the two years' course for rangers and the three years' course for the provincial staff. Overcrowding at Dehra is to be avoided by the establishment of a school for rangers in the Madras Presidency, with at least two professors from the Imperial staff, and probably another school on similar lines will be established in the Central Provinces. Indian forest schools have to provide foresters for Kashmir, Mysore, Hyderabad, and the other native States, besides for British India, and Mr. Wilmot has recently been deputed to Nepal to organise a suitable forestry department there.

It is evident that schools of forestry, at home, in India, and in the colonies, must be in close touch with the universities; but while Indian universities have a suitable English and scientific entrance examination, this is not yet the case with some of our most important home universities, and this defect calls loudly for reform in the best interests of our Empire. The prospects of forest technology in India are now very high, and it is to be hoped that, following the example there and that of South Africa, where a forest school has been established, the Dominion of Canada, Newfoundland, Australia, and New Zealand will soon bestow sufficient attention on forestry and establish local forest schools. Besides India and South Africa, the scientific forestry of which has been long established, there are regular forestry departments in Ceylon, the Malay States, the Soudan, British East Africa, Mauritius, Cyprus, and in some of the West Indian Islands.

W. R. FISHER.

THE TWENTIETH-CENTURY SPORTSMAN.[1]

THIS amazing picture-book (recommendable, among a hundred other reasons, in that, though large in size, it is very light to hold in the hand) will probably *faire école*. That it has made a sensation amongst the reading public interested in Africa is already observable by the reviews of it which have appeared in the leading newspapers, and the vogue it has attained in spite of the conflicting interest of current politics. This is little to be wondered at. The author (who is the brother of the Captain W. R. Dugmore who distinguished himself in Uganda and elsewhere as a soldier-pioneer) had, no doubt, supreme

[1] "Camera Adventures in the African Wilds; being an Account of a Four Months' Expedition in British East Africa, for the Purpose of Securing Photographs from Life of the Game." By A. Radclyffe Dugmore. Pp. xviii+231. (London: William Heinemann, 1910.) Price 30*s.* net.

FIG. 1.—Telephoto of Kilimanjaro about eighty miles away. The entire lack of detail on the lower part of the mountain is due to atmospheric effect, which renders distant objects the colour of the sky unless they are above the heated stratum near the earth. From "Camera Adventures in the African Wilds."

Fig. 2.—Large Herd of Giraffe and Grant's Zebra, showing the comparative sizes of the two strongly marked animals. (Telephotograph at about 300 yards.) From "Camera Adventures in the African Wilds."

good luck, but he and his companion, Mr. James L. Clark, were also possessed of singular courage and skill both as photographers and marksmen, and, if need be, mechanicians. Good luck gave them the chance of a telephotograph of Kilimanjaro, eighty miles distant, which is one of the weirdest mountain pictures the present writer has even seen, and confirms his old story of twenty-five years ago that Kilimanjaro, in certain aspects, resembled Swift's floating-island of Laputa. Amongst other episodes of singular good fortune was the photographing of the still very rare black Forest pig. This creature, the existence of which was rumoured by Stanley, George Grenfell, and the present writer in the Congo Forests, was actually first revealed to science by Captain Meinertzhagen and Mr. C. W. Hobley, far away from the Congo basin, on the Nandi plateau and round Mount Kenia (though it was soon afterwards obtained from the north-east Congo, and finally from the Cameroons). But specimens of it are still scarcer than those of the okapi, and to have photographed the creature, *wild and in its forest home,* is an episode that probably Mr. Dugmore never anticipated, even in his rosiest anticipations.

The book gives unrivalled pictures of the fauna of Equatorial East Africa, of that singularly fascinating region between Kilimanjaro on the south and the Guaso Nyiro on the north, the Rift Valley on the west and the Tana River on the east. Here there are long ranges of mountains that only fall just short of the level of perpetual snow, and there are the snow-fields and glaciers of Kenya, rendered marvellously well in Mr. Dugmore's pictures. Immense grassy plains, dense thorn scrubs, lakes peopled with flamingoes, splendid equatorial forests recalling those of West Africa, deep water-courses or canyons, broad rivers with great herds of hippopotami and monstrous crocodiles, and patches of camel-frequented desert—all these phases of physical geography are admirably illustrated, in addition to the pictures of beasts, birds, and indigenous mankind. We are getting almost tired of lions since the advent on the scene of the flash-light photographer: the lion and lioness, indeed, seem to be almost like the popular actress or politician in their desire and willingness to be photographed in interesting attitudes. But although this book has some of the best lion pictures I have ever seen, it will probably be more noteworthy for its photographs of charging rhinoceroses, of buffaloes passing through the long grass, or hiding themselves at noon-day in dense forest. Another notable feature is the numerous studies of giraffes, sometimes looking exactly like withered tree stumps, at others suggesting prehistoric monsters. The most striking of these giraffe studies (and the most beautiful) is that where, by means of a telephotograph, a large herd of giraffe, and a smaller herd of Grant's zebra, are shown together in an immense tract of savannah country dotted with acacias. If that does not suggest the Pleistocene at its best, we do not know what does, The geographical scope of the book extends far enough north to include the Samburu and their camels, camels which have suggested to more than one observer, British or Italian, the possibility of their being derived from a wild camel which may still exist in the remotest, as yet completely unexplored, parts of Galaland.

The book opens with an appeal "to the lovers of sport, and perhaps to those who consider themselves as such, but whose only claim is the insatiate love for killing which characterises their idea of sport." The author goes on to state that, like many others brought up to the use of firearms, he considered the man who did not shoot a very inferior person, in fact, unmanly. But as the years went by he himself became more deeply interested in natural history, and the idea of killing for killing's sake lost its fascination. In time he found that the most thrilling sport of all was the studying of the life of animals in their native wilds rather than in the killing of them merely to possess the skin or other trophies. Enough is said in his book to show that he and his companion ran, perhaps, greater risks in their attempt to snapshot charging rhinoceroses, lions, and buffaloes than would the sportsman who was merely out to kill, while the acrobatics necessitated in natural-history photography are enough to prove that the follower of this sport has to be a far more athletic and courageous person than the mere shooter.

Whether Mr. Dugmore will meet with any more success in his appeal than has followed the work of Mr. E. N. Buxton, and others of like persuasion is a moot question. His unsurpassed photographs have revealed once more the wonderland in bird and mammalian fauna represented in Inner East Africa, and already a company, with an office in Piccadilly, has issued a pamphlet on British East Africa, illustrated by some of Mr. Dugmore's photographs, which offers every inducement to persons of both sexes to proceed to East Africa "to shoot." In this pamphlet it is stated that the report about the country being "shot out" is far from the actual truth. (Nothing, so far as I can see, is said about the attractions to the photographer.) In the list of animals which may be shot under the ordinary licence (and in this the pamphlet is not to blame, for it merely quotes official regulations) is given "four egrets of each species." What of its kind can be more monstrous than this? Egrets —white herons—are quite uneatable, they are supremely beautiful, and we now know—or ought to know—that they are large consumers of noxious flies —Glossina (tse-tse), Stomoxys, Tabanus—and all the larger gnats. For this reason alone all these smaller herons should be rigidly protected.

H. H. JOHNSTON.

WIND STATISTICS AND AËRONAUTICS.

THE practical interest shown in Germany in the navigation of the air is widespread, and goes hand in hand with a determination to utilise all auxiliaries that promise to advance the subject. Among such auxiliaries must be included the observations of wind which form part of the stock in trade of the meteorologist. The "Motorluftschiff-Studiengesellschaft" of Berlin, founded in 1907 at the instance of the German Emperor, has accordingly requested Prof. Assmann, the director of the Aëronautical Meteorological Observatory at Lindenberg, to undertake a detailed analysis of the wind data available for the German Empire. The society has provided a large part of the funds required for the work. The results have now been published. They give average values, generally for the twenty years 1886–1905, for forty-nine stations. The original schedules were prepared in the various offices which are responsible for the meteorological work of the component States of the Empire. The final discussion was undertaken at Lindenberg under the direction of Prof. Assmann.

Some idea of the magnitude of the work involved may be gathered from the fact that the preparation of the primary schedules is estimated to have occupied about 2550 hours of clerk's time. It was decided to limit the discussion to the Beaufort estimates of

[1] "Die Winde in Deutschland." Im Auftrage der Motorluftschiff-Studiengesellschaft in Berlin. Bearbeitet von Richard Assmann. Pp. iv+48; tafel xiii. (Braunschweig: F. Vieweg und Sohn.) Price 5 marks.

"I Venti in Italia." Estratto dalla Rivista Tecnica di Aeronautica e Boll. della Soc. Aeronautica Italiana. Dott. Filippo Eredia, Meteorologista al R. Ufficio di Meteorologia e Geodinamica. (Roma: Officina Poligrafica Italiana, 1909.)

wind force and direction made at selected stations of the second order. A discussion of the results obtained by anemometer was not attempted, on the ground that differences of exposure and of the types of instruments rendered instrumental results less trustworthy than Beaufort estimates, so far as comparability with one another goes—a striking testimony to the value of the latter, if carefully made. The main tables give for each station the percentage frequency of wind from each of eight principal directions. The winds from each direction are then subdivided according to wind velocity, five gradations ranging up to 15 m.p.s. being distinguished. Values are given for the whole year and for each quarter separately.

The last chapter of the work is devoted to a discussion of the results for the upper air obtained with kites at Lindenberg. Tables of averages, similar to those prepared for individual stations, are given for each step of 500 metres up to a height of 4000 metres.

In "I Venti in Italia" we have a publication which is inspired by much the same idea. It has been prepared at the instigation of the Italian Aëronautical Society, and gives information for 111 stations in Italy. As in the German work, the observations are grouped under the eight principal wind directions, but the subdivision by wind forces is not carried out. To make up for this omission, the results for the country as a whole are shown graphically on a series of coloured plates included in the final section. In a country like Italy, where there is a marked seasonal variation of wind direction, a pictorial representation is very useful. The work has been entrusted to Dr. Filippo Eredia, of the Central Meteorological Office of Italy, whose name is a guarantee of careful workmanship.

We cannot discuss the statistical details; he who is interested in the influence of topography on air currents will find much useful information in the very complete wind-roses given with both works. The results will also be useful to aëronauts when selecting sites for practising grounds or for aërial harbours, or in such matters as the selection of the seasons most appropriate for their experiments.

NEW GUINEA PYGMIES.

IN the last number of *Country Life* (vol. xxvii., p. 797) Mr. W. R. Ogilvie-Grant, under the running title of "The Expedition of the British Ornithologists' Union to the Snow Mountains of New Guinea," published his fourth article, entitled "The Discovery of a Pigmy Race," part of which appeared in the *Times* on June 3. All the information we have at present is that the expedition ascended the Mimika river, and at "an elevation of about two thousand feet they came across a tribe of pigmy people, of whom the tallest stood about four feet six inches, the average height being four feet three inches. Though at present no further details have been received except that they were extremely wild, there can be little doubt that they belong to that distinct division of the human race known as the Negritos." Mr. Ogilvie-Grant added a short account, with illustrations, of the Semang, a Negrito people of the Malay Peninsula.

Although stature cannot be taken as a trustworthy criterion of race, as it is very variable, there are certain peoples who can be described as normally tall, medium, or short; those whose stature falls below 1·5 m. (4 feet 11 inches) are usually termed pygmies, such as the Negrilloes of Central Africa, Andamanese, Semang of the Malay Peninsula and Sumatra, and Aetas of the Philippines, the three latter being usually grouped together as Negritos. The Negritos are characterised by having short ulotrichous (woolly) hair, very dark skin, moderate brachycephalism, and pygmy stature.

In a valuable essay, "The Negritos" (1899), Dr. A. B. Meyer critically examined the evidence of the distribution of this race, and, so far as New Guinea is concerned, stated that

> "A Negritic race side by side with the Papuan race nobody has been able to discover just because it does not exist, and it does not exist because the Papuan race, in spite of its variability, is on the one hand a uniform race, and on the other as good as identical with the Negritos" (p. 85).

When reviewing this essay in NATURE (September 7, 1899, p. 433), I stated that I was inclined to adopt the view that the various types exhibited by the natives of New Guinea "point to a crossing of different elements," and do not "simply reveal the variability of the race," as Dr. Meyer is inclined to believe. While agreeing with Dr. Meyer that the different conditions of existence (p. 80) in New Guinea probably have reacted on the physical characters of the natives (about which, however, we have extremely little precise information), we have now sufficient evidence to prove that the indigenous population, or true Papuans, has in places been modified by intrusions from elsewhere, and of late years data have been accumulating for the probability of the existence of a pygmy population, which may consist of dwarfed Papuans, or more probably represents a Negrito stock.

In *Globus* (Bd. xcvii., May 12, 1910, p. 286), Dr. O. Reche, in describing a journey up the Kaiserin-Augusta River, says that—

> "the population consists of three clearly distinguishable types or races, two of which have long, very narrow skulls, and one a short, broad skull. Inland from the river bank there seems to be in addition to these a pygmy-like people of small growth; at all events, I found in some of the villages situated on the upper river, among other skulls, some which were remarkably small and of a special type which must have been taken from enemies living farther inland."

Dr. Rudolf Pöch stayed from December, 1904, to February, 1905, in the Kai area, which lies inland from Finschafen, also in German New Guinea. In the *Mitt. aus den deutschen Schutzgebieten*, 1907, he writes (p. 225):—

> "During the first part of the time I remained chiefly on the Sattelberg itself, and observed and measured the numerous Kai frequenting the Mission station. In them I became acquainted with a mountain tribe entirely differing from the coast peoples previously visited. In fifty men I found the average height to be 152·5 cm. [5 ft.]; the skulls are, as a rule, mesocephalic to brachycephalic. Towards the coast (Jabim) dolichocephaly becomes more usual, and the type also changes. Very small people are not infrequently met among the Kai. I have already dealt with this remarkable phenomenon elsewhere,[1] and will not repeat myself here, but simply give the figures. Among 300 adult males I found 9 [*sic*] individuals, *i.e.* three per cent., below 146 cm. [4 ft. 9½ in.] in height. The statures measured were: 133 [4 ft. 4½ in.], 135, 138·2, 139, 139·1, 140, 143, 143·1, 143·2, 145·4, 145·5, 145·6 [4 ft. 9¼ in.]. Fig. 1 shows three of these small Kai people. For the present it cannot be determined whether this is merely a variation in stature or whether we have here survivals of an older smaller race not yet entirely merged into the Kai."

In the *Zeitschr. für Ethnol.*, 1907, p. 384, Dr. Pöch states that the median height of the Kai men is 152·5 cm. (5 feet), that 3 per cent. have a stature less than 140 cm. (4 feet 7 inches), and he goes on to say that on the north coast of British New Guinea and in Normanby Island he often came across very small

[1] *Sitzungsbericht der anth. Gesellschaft in Wien*, 1905, p. [40] ff.

people. This agrees with the experience of other travellers.

The English expedition has now discovered a pygmy population in Netherlands New Guinea, which presumably is allied to that inhabiting German New Guinea, and, judging from their stature, which is all we have to go upon, we may regard them as being very little, if at all, mixed with a Papuan element. From the descriptions and illustrations given of t pygmies from German New Guinea, there is little doubt that they are Negritos or Negritos crossed with Papuans, and doubtless the same will be found to be the case for those from Netherlands New Guinea.

Several travellers, such as Guppy and Ribbe, report the occurrence of very short people in the interior of the larger islands of the Bismarck Archipelago and of the Solomon Islands; but there is no evidence of a Negrito race still existing there as such, though the very short statures point to a Negrito mixture. This conclusion is strengthened by the recent investigations of Dr. R. Thurnwald (*Zeitschr. für Ethnol.*). He refers to very small people in the mountainous interior of Bougainville, and he measured (p. 109) one man from Mari mountain with a stature of 1·39 m. (4 feet 6½ inches). These people speak a non-Melanesian language. He informs us that "In the people nowadays met with in these mountains we have before us, however, no unmixed race, but, besides representatives of a small, short-legged, broad-faced, short-skulled, more hairy, wide-nosed people, we encounter types recalling the Solomon Islanders. . . . Whether this mountain type is really dwarfish, as the legend goes, must remain undecided." Rascher states that the existence of dwarfs is commonly believed in New Britain. They are reported to live in clefts in the rocks and steal fruit from the gardens. They are so tiny that one stands on the shoulders of another, and so on, until they reach the fruit. The fruit is not thrown down, lest a noise would be made, but passed from hand to hand, until it reaches the chief, who is on the ground.

A. C. HADDON.

NOTES.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 18.

AT the request of the Association of American Agricultural and Experiment Stations, Prof. J. C. Ewart, F.R.S., of Edinburgh, will give a course of lectures on the principles of breeding, at Ames, Iowa, in July.

M. DARBOUX, permanent secretary of the Paris Academy of Sciences, has been elected president of the Société de secours des Amis des Sciences, and M. Picard, president of the academy, has been elected vice-president of the society.

WITH the view of collecting material for the life of the late Prof. Alexander Agassiz, we are asked to state that anyone having any of his letters will confer a favour by sending them to his son, Mr. G. R. Agassiz, Museum of Comparative Zoology, Cambridge, Mass., U.S.A. The letters will be copied if desired, and the originals returned to the owner as soon as possible. If any persons are unwilling to part with the original letters, Mr. Agassiz would be glad if they would have copies made at his expense and send them to him at their convenience.

TO-DAY, at the University of Halle, the sixtieth birthday of Prof. W. Roux, the founder of the modern science of experimental embryology, is being celebrated. His numerous pupils and other admirers are expressing their appreciation of the magnificent work which he has accomplished for biological science in the manner customary in German universities, by the publication of a "Festschrift" and the presentation of an address. We do not doubt that we are expressing the feelings of all British biologists in offering to Prof. Roux our heartiest congratulations on this occasion, and in hoping that he will long continue to illuminate the study of animal development by his brilliant investigations.

A SEVERE earthquake occurred in the province of Avellino, east of Naples, at 3.5 a.m. on June 7. The disturbance caused considerable damage in Calitri—about fifty miles east of the town of Avellino—and Calabritto, another small mountain town. The shock was felt also in Naples, Benevento, and other places in southern Italy.

DR. DAVID STARR JORDAN, the president of Leland Stanford Junior University, California, will leave at the end of the academic year for Europe, where he will spend his first vacation for a quarter of a century. He expects to devote some of his time to the two-fold "holiday task" of promoting a zoological congress and assisting the peace movement.

AMERICA has lost a veteran science teacher by the death, in his seventy-fifth year, of Dr. G. F. Barker, who was professor of physics at the University of Pennsylvania from 1872 to 1900. He was appointed U.S. commissioner to the Electrical Exhibitions held at Paris in 1881 and at Philadelphia in 1884, and was a member of the jury on awards at the Columbian Exposition of 1893. In 1879 he was president of the American Association for the Advancement of Science. Prof. Barker was the first person to exhibit radium in America. The death is also announced of Dr. Franklin Clement Robinson, who had held the chair of chemistry at Bowdoin College, Maine, since 1874. He was president of the American Public Health Association in 1906. He was a frequent contributor to the American Chemical Journal, and had written text-books on the metals and qualitative analysis.

DURING the evening of June 2 Mr. C. S. Rolls travelled with a biplane from Dover to Sangatte, and, after circling over the semaphore station there, he returned to Dover, thus making the first double journey across the English Channel. The whole journey occupied 90 minutes, and was made at an average height of 800 feet. The Army experimental airship *Beta* made a successful flight from the balloon works at Farnborough to London and back during the night following June 3. On the journey to London the *Beta* travelled against a light wind from the north-east, and made a speed of 26 miles an hour. The greatest height attained during the flight was 1800 feet, and the mean altitude about 1000 feet. The engines of the airship are of 35 horse-power. The journey back from Southwark to Farnborough occupied 1h. 28m.

A BUST of Pasteur was unveiled in the garden of the École Normale Supérieure, Paris, on June 5. The *Morning Post* Paris correspondent reports that M. Lavisse, of the French Academy, made a speech in the name of the Normal School. He recalled the fact that Pasteur spent thirty-seven years in the famous college, and that his first laboratory consisted of two garrets in its buildings. He spoke of Pasteur's relentless warfare against the forces of nature hostile to man; it was only after five years study that he discovered the remedy for rabies. Above all things he was an indefatigable worker. "He called the interval of night 'hours of waiting,' which always seemed to him slow to pass." His method was based on two principles: first, on curiosity; secondly, on the determination to discover. M. Lavisse dwelt on Pasteur's faith in science and the fascination of mystery to his mind.

FOLLOWING upon the invitation to the British Association from the Corporation of Portsmouth to hold the annual meeting at that town next year, a public meeting, presided over by the Mayor, Sir William Dupree, was held recently, at which the names of several influential and well-known gentlemen were submitted as vice-presidents. Two local secretaries were appointed in Mr. G. Hammond Etherton, Town Clerk, and Dr. A. Mearns Fraser, Medical Officer of Health, and various preliminaries in preparation for the reception of the association were decided upon. The Corporation of Portsmouth is looking forward to the meeting with considerable enthusiasm, and a large sum of money has been voted to the Mayor for next year in order to enable him to extend the hospitality of the town to members of the association. Owing to the generous dimensions of the Portsmouth Town Hall, the adjoining Technical Institute, and several other large buildings in the immediate vicinity, exceptional facilities will be available for the various meetings of sections, discussions, and public functions, and everything points to a very successful meeting.

MR. J. B. N. HENNESSEY, F.R.S., whose death was announced in NATURE of May 26, was formerly deputy surveyor-general in charge of the Trigonometrical Surveys, Survey of India. He was appointed to the Trigonometrical Survey so long ago as 1844, and for some years worked in most unhealthy parts of India. For the following particulars of his career we are indebted to an obituary notice in the *Times*. While on long leave in 1863–5, Mr. Hennessey entered Jesus College, Cambridge, and worked under Profs. Adams, Challis, and Walton to improve his mathematical knowledge. He obtained sanction not only to learn photo-zincography at the Ordnance Survey, Southampton, but also to take out on return to duty an extensive apparatus, and to establish the process at the survey headquarters at Dehra Dûn. He taught the process to other officers, and the result was that in a few years hundreds of thousands of good maps were printed in place of those made by uncertain pen transfers. Not less important was Mr. Hennessey's work in taking in hand the vast accumulations of material provided by the labours of Lambton, Everest, and Waugh in their unrivalled trigonometrical operations, and reducing them to order by suitable scientific methods. The final results were brought together in fourteen large quarto volumes distributed gratis by the Government of India to scientific departments and associations throughout the world. Mr. Hennessey took a leading share in other scientific operations in India, including the determination of the standard bar, comparison of standards, and the measurement of base lines. He built two of the Indian observatories, and for the Royal Society mapped the telluric lines of the solar spectrum, and made prolonged actinometric observations. He was elected a Fellow of the Royal Society in 1875.

SIR FRANCIS SEYMOUR HADEN, who died on June 1, at ninety-two years of age, was chiefly known to the present generation as an etcher, and it was for his artistic achievements that he was awarded his knighthood. In his earlier days, however, he took a very prominent and important part in the progress of the medical profession. He was educated at University College, London, and continued his studies at the medical schools of the Sorbonne, in Paris, and of Grenoble. He became a Fellow of the Royal College of Surgeons of England, and honorary surgeon to the Department of Science and Art. He worked actively on various international juries dealing with the progress of surgical science. His report for the International Exhibition of 1862 gave an exhaustive review of European surgery. This report was chiefly remarkable for his earnest advocacy of the operation of ovariotomy, which had been ill-received up to that time. He was an active vice-president of the Obstetrical Society of London, and was chiefly instrumental in founding the Royal Hospital for Incurables. His name became prominently known in connection with the subject of burial. His investigations into the condition of the graves in a London churchyard which was in the course of being converted into a public garden showed the state of affairs to be indescribably revolting. He invented the *papier-mâché* coffin, and was a strong advocate of earth burial. He was strongly opposed to cremation, principally on account of its legal difficulties.

WE regret to see the announcement of the death of Dr. Elizabeth Blackwell, in her ninetieth year. She was the first woman to become a fully qualified medical practitioner, and the first woman whose name was placed on the British Medical Register. She lived many years in the United States, but never became denationalised. At the age of twenty-six she obtained entrance into the medical school attached to the University of Geneva, in the State of New York, where her "carefully hoarded earnings" just sufficed for her maintenance during her period of study. The professors declined to take the responsibility of admitting her; they referred it to the students. These were unanimously favourable to her admission, and pledged themselves that no conduct of theirs should cause her annoyance. On the completion of her studies at Geneva, N.Y., her degree was conferred in the presence of a great crowd. She came to England in 1849, and found much prejudice in professional circles. On coming to London in 1850 Mr. Paget (afterwards Sir James Paget), then Dean of St. Bartholomew's Hospital, gave her leave to attend the hospital as a student, and she was admitted to every part of the hospital except the department for the diseases of women! She studied for a year in La Maternité Hospital in Paris, where she had the misfortune to contract purulent ophthalmia from one of her patients. It cost her six months' illness and the sight of one eye, and ended her hope of making surgery her speciality. In 1851 she returned to America, and began practice in partnership with her sister Emily. She felt keenly the want of hospital practice, and established a dispensary, from which, in the course of time, there grew the New York Infirmary for Women, which was a women's hospital officered by women. On re-visiting England she had her name placed on the English register, and immediately afterwards an Act of Parliament was passed excluding the owners of foreign degrees from the register. In London she lectured on medicine as a profession for women. Among her audience was Miss Elizabeth Garrett (now Mrs. Garrett Anderson, M.D.). On the outbreak of the Civil War in the United States Dr. Blackwell returned to New York. She held the chair of hygiene in the Medical School for Women in New York, which was then established, and organised the services of sanitary visitors in the slums of New York in anticipation of modern developments. She returned to England, and had the "pleasure and privilege to encourage Dr. Anderson and Dr. Sophia Jex Blake in their pioneer enterprise in England." When the New Hospital for Women was founded she was on the consulting staff, and later, when the London School of Medicine for Women was opened, she held the chair of gynæcology until her health began to fail.

THE Christiania correspondent of the *Morning Post* contributes to the issue of our contemporary for June 6 some interesting particulars of Captain Amundsen's expedition to north polar regions, which started on that day. The

journey will be made in the *Fram*, which is thus now on her third polar expedition. Among the problems which Captain Amundsen hopes to solve are the extent, depth, and character of the polar basin. He proposes to measure exactly the temperature and salinity of the streams of the polar basin, and to work at tide gauging, ice screw measurement, and wind speed. Captain Amundsen is prepared for seven years' absence. Once across the Atlantic, he will return in August to Christiansand to fetch Eskimo dogs. A few days later the *Fram* will shape its course from Cape Horn to San Francisco, where coal and provisions will be taken in. In June, 1911, a start will be made for Point Barrow. The *Fram* will follow the moving ice over the polar basin, and it is hoped that the actual Pole or its near neighbourhood will be crossed. The object of the expedition is purely scientific. Captain Amundsen expects to reach open water between Greenland and Spitsbergen in 1915 or 1916.

In connection with the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease, Mr. Burns, the President of the Local Government Board, has authorised the following special researches. (1) A continuation of an investigation into protracted and recurrent infection in enteric fever, by Dr. Theodore Thomson, Medical Inspector of the Board, in conjunction with Dr. Ledingham, of the Lister Institute. (2) A continuation of an investigation into protracted and recurrent infection in diphtheria, by Dr. Theodore Thomson and Dr. C. J. Thomas. (3) A continuation of an investigation into flies as carriers of infection, by Dr. Monckton Copeman, Medical Inspector of the Board, in conjunction with Dr. Graham Smith and Mr. Merriman, of the University of Cambridge, Dr. Nicholl, of the Lister Institute, and Dr. Bernstein, of the Bacteriological Laboratory, Westminster Hospital. (4) A continuation of an investigation on the injurious gases evolved during artificial illumination, by Dr. J. Wade, of Guy's Hospital. (5) A preliminary inquiry into the relationship of certain special types of bacteria to the diarrhœa of infants, by Dr. C. J. Lewis, of Birmingham, Dr. Sheila M. Ross, of Manchester, Dr. Thomas Orr, of Shrewsbury, and Dr. R. A. O'Brien, of the Lister Institute.

The summary of the weather for spring, comprising the thirteen weeks in March, April, and May, just issued by the Meteorological Office, shows that the mean temperature for the period was nowhere very different from the average. The north-east and east of England were the only districts where the thermometer in the shade exceeded 80°; the highest temperature was 83° in the east of England, and the lowest 20° in the north of Scotland and in the south-west of England. The aggregate rainfall for the period varied in different parts of the United Kingdom, the total measurement being in excess of the average in the north and east of Scotland, in the east, south-east, and north-west of England, whilst in all other districts there was a deficiency. With the exception of the north of Scotland, where there was an excess of 3 inches, the difference from the average was nowhere large. The number of rainy days was in excess of the average in all districts except in the east of Scotland and in the Channel Islands. The largest measurement of rain was 12·91 inches in the north of Scotland, which fell on 60 days; the least measurement was 4·87 inches, in the Midland counties, which fell on 47 days. The duration of bright sunshine was nowhere very different from the average; the greatest excess was 28 hours in the south-west of England, and the greatest deficiency 40 hours in the south of Ireland. At Greenwich the mean temperature for the three months was 0·3° above the average, the rainfall was 0·93 inch more than the normal which fell on 45 days, and the duration of bright sunshine was 66 hours more than usual.

In the spring of 1909 the board of governors of the Camp-Fire Club of America decided that the time was ripe for instituting an active campaign for the protection of wild life throughout the United States. With this object in view a legislative committee, consisting of twelve lawyers and a zoologist, was formed. Special attention has been directed to the preservation of the grey squirrel and the fur seal, and to convincing the authorities of the desirability of placing all migratory birds under the control of the Federal Government. We have received a report showing the steps which the club has taken in the direction of saving the fur seal. For fully ten years the fortunes of the Alaskan fur seal, which once furnished a valuable industry, have been rapidly declining. Last November the club decided to appeal to Congress, the President, and the Cabinet for the adoption of a policy that would not only save the seals from further annihilation, but also rehabilitate an industry that, instead of yielding an income, now inflicts an annual loss. The club asked for three things:—no renewal of the lease for killing seals on the Pribilov Islands for commercial purposes; a ten-year close season for the seals; and treaties with Canada, Japan, and Russia for the total suppression of the industry of killing seals at sea. On April 21 a Bill securing some of these ends was signed by the President after having passed both houses of Congress. It is hoped that treaties with the other countries interested will be arranged. It may be predicted that the seal herds, now reduced from 4,000,000 to about 60,000, will have a much needed rest, and that if the killing of seals at sea, called "pelagic sealing," can be stopped by treaty, in ten years' time the herds will breed up to their original strength.

In the May number of *Man*, Mr. N. W. Thomas commences a series of notes on his recent work in Nigeria. In the present instalment he describes one phase of native decorative art, that to be seen on the walls of houses secular or religious. Human figures, except that of a mischievous imp, Esu, are rare; but numerous animal forms are depicted, and these, particularly when found on the walls of shrines, seem to subserve a magical purpose.

Many suggestions have been made to explain the term Rom or Romani applied to the Gypsy race. The last is that of Mr. Leo Winer in the Journal of the Gypsy Lore Society for April. He points out that the name is coincident with Christian countries only, Europe, America, and Armenia. From the law of Charlemagne it appears that the Gypsies pretended to be pilgrims, and their name was usually connected with that of Rome. Ultimately, he thinks, it originated in the Greek Erimites, "a hermit" and that when the popular etymology connected all hermits and pilgrims with Rome, all other terms designating pilgrims were so transformed as to bring them into keeping with this new conception.

Mr. C. L. Wragge announces in the *Auckland Standard* of March 7 the discovery at Bay of Islands of a series of engraved rocks, which he supposes to be of enormous antiquity and to be connected with the monoliths of Easter Island, which are a puzzle to antiquaries. Another correspondent, however, states that there are rocks between Whangaroa and Bay of Islands regarding which the Maori have traditions dating back to the days of Captain Cook and that a Government geologist who examined them has found that they are naturally decayed basaltic columns.

Mr. Wragge declines at present to give details of his discoveries, and until these are published it is unsafe to venture any opinion in regard to them.

The Entomological Research Committee for Tropical Africa, appointed by the Colonial Office, has issued the first number of the Bulletin of Entomological Research, on which the committee and the editor (Mr. G. A. K. Marshall) may be warmly congratulated. Nearly half the number is occupied by Mr. W. Wesché's descriptions of the larval and pupal stages of West African Culicidæ, a most useful paper, giving characters for the identification of the larvæ and pupæ of twenty-nine species of mosquitoes, illustrated by seven excellent plates. The collector of the specimens, Dr. W. M. Graham, adds valuable field-notes, and the facts recorded are important alike to the entomologist and the medical man. Dr. Drake-Brockman contributes a short paper on blood-sucking Diptera from Abyssinia, Mr. R. Newstead writes on Coccidæ from Uganda, and Mr. E. E. Austen describes new African fruit-flies and a new Cordylobia—a muscoid genus the larvæ of which are subcutaneous parasites. In a short preface Mr. A. E. Shipley discusses the general work of the committee, mentioning that two experienced entomologists have been sent out for the purpose of research and instruction—Mr. S. A. Neave to Nyasaland and Mr. J. J. Simpson to Nigeria.

The following interesting communication has reached us from Mr. Christopher Morse, of 3 Gladstone Road, Deal:—"All your readers have, of course, noticed a cat washing its face, but I expect very few have seen the same operation being carried on by a caterpillar. I observed one engaged in this process yesterday, and thought it a matter of interest. The creature was a smooth-bodied Noctuid larva feeding on grass." Of course, it is well known that butterflies often drink up water eagerly, and even bathe in it; while, as regards caterpillars, the drinker moth (*Cosmotriche potatoria*) derives its name from the caterpillars' fondness for water, often plunging their heads into the drops of water on the grass on which they feed (compare Tutt's "British Lepidoptera," iii., p. 167). Mr. Tutt, to whom we have submitted Mr. Morse's communication, thinks that in most cases the true legs of caterpillars would be too short to be used for washing the face (though in some exceptional cases these are long), and adds, "Of course, butterflies do it, and are well provided sometimes with hooks for the purpose, especially for cleaning their antennæ. They often have the appearance you name when thus employed. I think I noticed it particularly in *Rusticus betulae* and certainly some other species." It would be of interest if Mr. Morse could continue his observations, and especially identify the species of caterpillar which he noticed washing its face.

A new geological society, already very well supported, styled the Geologische Vereinigung, has been established at Frankfurt am Main, somewhat on the lines of the English Geologists' Association. While international in character, it aims especially at providing summaries of important geological work, which shall reach the increasing number of teachers of geology. By organising excursions, it hopes to come into touch with those who have charge of classes in schools. The subscription is only 10 marks annually, and each member will receive the society's journal, the *Geologische Rundschau*, the first number of which, published on April 26, is now before us. As the six numbers of this journal cost 12 marks a year (Leipzig: W. Engelmann), it is clearly profitable for readers also to become members of the society. The journal is edited by Drs. G. Steinmann, W. Salomon, and O. Wilckens, and is another sign of the activity of already busy men. Two original papers appear in this number which might easily have found a place in the older journals; but the signed reviews of geological knowledge are the main feature, and rank with those on current subjects in the English quarterly, *Science Progress*. The professional worker can, of course, rely on Keilhack's *Geologisches Zentralblatt*, which notices practically everything. The *Rundschau* is at once more literary and more limited in character, and has a critical usefulness of its own.

Prof. E. A. Martel makes a vigorous contribution to the controversy regarding the existence of *Grundwasser*, or a water table supported by an impermeable stratum, in the Karst region, in a recent number of *La Géographie*, p. 126. Prof. Martel considers that definite proof of the non-existence of such an underground reservoir feeding the subterranean rivers of the Karst is now available, and that the question is finally settled.

In Nature of May 12 (p. 319) reference was made to the important additions made to the monthly meteorological charts of the North Atlantic issued by the Meteorological Committee by the publication of current daily weather charts of barometrical pressure, temperature, and wind, compiled from reports by radio-telegraphy and through other sources. The value of these data is still further enhanced in the chart for June by a short discussion of the predominant features indicated by the maps. These show, *e.g.*, that from May 5–11 inclusive an area of high barometric pressure occupied a considerable portion of the Atlantic, and, in connection with the low pressure existing over these islands and Europe, was responsible for the abnormally cold and squally weather then experienced over this country. At the close of the period the advance of an anticyclone, shown to be moving from Barents Sea to Scandinavia, and the shifting of continental disturbances towards north-west, tended to modify those conditions. The unique reports of ice received by the committee show that icebergs were being sighted with increasing frequency between 42° and 52° N. latitude, and 39° and 52° W. longitude.

In two papers contributed to the Proceedings of the American Academy of Arts and Sciences (xlv., 8, 9) Mr. Harvey F. Davies discusses the applicability of the law of corresponding states to the Joule-Thomson effect in water and carbon dioxide, with special reference to temperatures above 100° C., and gives a new formula for the total heat of saturated steam, which holds good within limits of error between 65° and 190° C. This formula really represents the difference of the total heat from that at 100° C., the value of which is assumed from previous work.

At the 1908 Mathematical Congress at Rome Profs. C. Burali Forti and R. Marcolongo were appointed to draw up a report on the various notations of vector analysis with a view to unification. A critical review of their publications on this subject is contributed to the May Bulletin of the American Mathematical Society. It appears that the writers propose to avoid the use of the familiar "nabla," observing that this operator has different meanings as applied to scalar and vector functions; but this and the other points raised in the paper do not admit of adequate discussion in the present brief reference. The subject is of interest both to mathematicians and physicists, but it is clear from Prof. E. B. Wilson's reviews that much remains before a final system can be adopted.

It is now more than twenty years since Profs. Hertz and Hallwachs showed that when a metal plate charged with negative electricity and insulated is illuminated by ultra-violet light it loses its charge, and the rate of loss under standard conditions decreases with time. To the latter effect the title "photo-electric fatigue" was given. It was thought by some to be due to oxidation of the surface, by others to the direct action of the impinging light. Although Hallwachs disproved both these views six years ago, a considerable amount of work has been done recently by experimenters, who apparently still approach the subject from the point of view of the direct action of light, *e.g.* Dr. Aigner, of Vienna, Dr. Allen, of London, and, according to the *Résumé des Communications* of the Société française de Physique for May 6, M. Eugène Bloch, of Paris. All doubt as to the possibility of the incident light being the direct cause of the fatigue appears now removed by the experiments of Dr. Ullmann (*Annalen der Physik*, 1910, No. 6), who has traced it in the case of both copper and zinc to the formation of ozone in the air surrounding the plate by the passage of the light through it.

Messrs. F. Davidson and Co., 29 Great Portland Street, W., have given us an opportunity of examining the thermo-generator—a new form of the old thermopile—of which they are the agents for England and the colonies. The thermo-electromotive-force is produced by copper-antimony couples, fifty of these couples being connected in series. Each couple consists of a vertical, hollow, cylindrical copper tube, to the top of which is soldered a flat strip of antimony, which passes horizontally inwards and then downwards around a block of a porcelain-like substance. The copper tubes are arranged in two parallel rows of twenty-five each, and the antimony strips approach one another at the top. These strips are heated by means of a horizontal burner running the whole length of the apparatus immediately beneath the antimony strips. Gas or methylated spirit vapour is used for producing a number of jets, and the heat is retained in the white blocks which are in close contact with the antimony strips. An electromotive force of about 4 volts is obtained, and this is sufficient to illuminate a small lamp for medical or other purposes, or to run a small model lathe or fan. A total current of 3 amperes can be obtained through a galvanometer provided there be no appreciable external resistance. Less than one minute is required to heat the apparatus sufficiently to give its full yield. A slight deposit of oxide forms upon the surface of the antimony in the course of time, and requires to be removed by running a stick lightly between the rows while the apparatus is hot; otherwise it appears to give no trouble whatever. The thermo-generator may be used for hours continuously, and takes the place of dry batteries for running small illuminating lamps.

Sir William White contributes an interesting article on marine steam turbines to the *Engineer* for May 27. In reference to the excessive complication which has been charged against the Parsons type, and the greater simplicity credited in some quarters to the German arrangements, the author points out that, after large experience in the great Cunarders and in swift armoured cruisers, no serious practical difficulty has been experienced with Parsons turbines. Their advantages in regard to economy of steam consumption, greater ease of handling the engines, and smaller individual weights to be lifted when opening out turbines, have been proved to be considerable. Sir William is convinced that, on the whole, the Parsons type of turbine still maintains its superiority for marine purposes; but he is also of opinion that neither it nor any other type will secure universal adoption or be absolutely the best suited for all the varied cases which occur in practice.

An account of the trials of the Brazilian battleship *São Paulo* appears in *Engineering* for June 3. This ship is the product of Sir W. G. Armstrong, Whitworth and Co. and Messrs. Vickers, Sons and Maxim. The full speed on trial—21·623 knots—was realised with 28,645 indicated horse-power, while the guarantee was for 21 knots. Of special interest are the gunnery trials, which took place on June 1 off the Clyde. A complete broadside of eleven 4·7-inch guns was fired simultaneously with a broadside of ten 12-inch guns, establishing a record in the way of broadsides. Admiral Bacellar, the president of the Brazilian Naval Commission, pressed the firing key which fired this tremendous broadside; every one of the twenty-one guns responded. Excellent practice was also made at a target. Another important feature was the firing of two 12-inch guns in an upper turret, laid horizontally and fore-and-aft directly over a lower turret. Several Brazilian and two British officers remained in the lower turret during this test, and were able to state that they were not inconvenienced by any concussion. The ship is fitted with an electrical firing system, which renders it quite impossible to fire any gun in a position which is dangerous to any other gun or any ship's fitting.

We have received from Mr. E. Merck, of Darmstadt (and 16 Jewry Street, E.C.), his catalogue of chemical preparations for April, 1910. The list is remarkably complete and it would be difficult to name any preparation required for general laboratory use which is not included. Many additions have been made to the last list, especially in therapeutical and bacteriological preparations.

The current number of the Bulletin of the Société d'Encouragement pour l'Industrie nationale (April, 1910) contains a very readable and interesting paper by Capt. Nicolardot on the rare earths and incandescent lighting. The pioneer work of Auer is described in detail, together with the history of the search for ceria and thoria, and an account given, with illustrations from photographs, of the manufacture of a mantle, starting with the quarrying of the monazite sand, and finishing with the burning off and fixing the mantle. The chief types of burner are also figured and described, including the latest forms of inverted burner.

A catalogue of the first eight hundred negatives made by the Geological Survey to illustrate subjects of geological interest, and of which prints or lantern slides are supplied at a fixed tariff, has just been published by the Board of Agriculture and Fisheries. The districts included lie chiefly in Cornwall and Devonshire, South Wales, and the counties of Cardiganshire, Derbyshire, Leicestershire, and Nottinghamshire. Copies of the catalogue may be obtained from any agents for the sale of Ordnance Survey maps, or directly or through any bookseller from the Ordnance Survey office, Southampton, price 6*d*. each.

Messrs. Heynes Mathew, Ltd., of Cape Town, have sent us a copy of a very complete illustrated catalogue of scientific apparatus, pure chemicals, and reagents. The list shows strikingly the improvement which has taken place in recent years in the supply of apparatus and material for scientific work in distant parts of the Empire. Messrs. Mathew have established a depôt in Cape Town where a full range of laboratory requisites can be obtained from stock. That they find it worth while to do this is suggestive testimony to the growth of science teaching in South African schools and colleges.

MESSRS. HARPER AND BROTHERS announce for publication during June "The Science of Happiness," Dr. Henry S. Williams; "The Elements: Speculations as to their Nature and Origin," Sir William A. Tilden, F.R.S.; "Religion and Art in Ancient Greece," Prof. E. A. Gardner; "Electric Trains," H. M. Hobart; and "Continuous Current Machine Design," W. Cramp.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JUNE:—

June 9. 5h. 3m. Neptune in conjunction with the Moon (Neptune 4° 40′ S.).
,, 16h. 16m. Mars in conjunction with the Moon (Mars 3° 6′ S.).
15. 1h. 56m. Jupiter in conjunction with the Moon (Jupiter 3° 9′ S.).
17. 2h. 0m. Mars at greatest heliocentric latitude N.
19. 1h. 0m. Venus at greatest heliocentric latitude S.
,, 14h. 0m. Mercury at greatest elongation (22° 43′ W.).
21. 19h. 49m. Sun enters sign of Cancer.
24. 3h. 58m. Uranus in conjunction with the Moon (Uranus 3° 50′ N.).
27. 17h. 0m. Jupiter at quadrature to the Sun.

HALLEY'S COMET.—With clear intervals between clouds during the past week, Halley's comet has not been a difficult naked-eye object for anyone who knew its position approximately.

Mr. Langton Cole reports that it was well seen at Sutton, Surrey, on May 22 and 31, and on the former occasion a short tail was visible to the naked eye; he estimates that on May 31 the comet was about as bright as a star of the third magnitude. At Gunnersbury on June 1 a naked-eye observation revealed the comet as early as 9·15 p.m., when it was apparently fainter than η Leonis (mag. 3·6).

A number of interesting notes on observations of the comet at various European observatories appears in Nos. 4413 and 4414 of the *Astronomische Nachrichten*. In the earlier number Dr. Franz records that on May 13, at the Breslau Observatory, the comet did not appear to be so bright as on earlier days; a variability of brightness is suggested, and it will be interesting to see if this is confirmed by other observers.

In No. 4414 many observers record that no trace of the comet could be detected on the solar disc during the time of transit. Dr. Wolf directs attention to the Bishop's rings surrounding the sun and moon on May 19, and suggests that they were more intense than if due solely to atmospheric effects. Meteors and auroræ were looked for at the Königstuhl Observatory, but were not seen.

Polariscope observations at several observatories gave similarly negative results. Prof. Franz records that on May 19 two bright arcs of light were seen in the northwest at Breslau, and may have been due to the comet. According to a telegram from Prof. Sykora, the projection of the comet on the sun was observed at Tashkent at 21h. on May 18. An increased intensity of the twilight at Odessa on May 18 is ascribed by Prof. Donitch as possibly due to cometary matter. Herr Archenhold reports a second comet-like object 1° south of Halley's comet at 9h. 30m. (Berlin M.T.) on May 22, but the observation is not confirmed by special reports from Bergedorf and Heidelberg. At Sonnwendstein, where, at an altitude of 1523 metres, several German observers had gathered for observations of the comet, the tail was observed from May 12 to 19. During this period its apparent length increased from 32° to 140°; its apparent position was the same on May 19 as on May 18. Dr. Hartmann, who was one of the party at Sonnwendstein, submits a special report dealing with the various aspects of the tail, and directs attention to the yellowish colour of the nucleus on May 20.

A number of notes dealing with observations of the comet were read at the meeting of the Paris Academy of Sciences on May 30, and appear in No. 22 of the *Comptes rendus*.

M. E. Marchand reports that observations made on the Pic du Midi and at Bagnères-de-Bigorre were badly interrupted by clouds. No striking special phenomena were witnessed on May 18 and 19, but it was noted that the dawn was especially bright and the sky tinted, as though there were an exceptional amount of dust in the atmosphere; the appearance is likened to that which was observed in 1902 and 1903 after the Martinique eruption. The unusual halos around the sun and moon support this view, as do also the observations of solar radiation subsequently made at the Pic du Midi station. Observations of the sun and of terrestrial magnetic and electrical effects revealed no abnormal condition attributable to the presence of the comet.

M. Popoff reports on the observations made at the Sofia Observatory (Bulgaria), and could not detect the comet projected on the sun's disc.

Further observations made at Athens are dealt with by M. Eginitis, who describes the forms of the nucleus and tail on May 18–20. No extraordinary atmospheric effects were recorded, and only two meteors were seen during the night of May 18. A splendid bolide was observed in Thessaly at 13h. 15m. (M.T. Athens), but is not connected with the comet. Between 7 p.m. and 8 p.m. on May 20 the comet's tail was seen with the equatorial, and was still apparently directed towards the west. The curvature was so great that the earth could not pass through the tail before the night of May 20.

MM. J. Baillaud and G. Demetresco describe photographs taken at the Paris Observatory on May 23, 24, and 28. Only very short exposures (thirty seconds to five minutes) were possible, and the tail is not shown. The nucleus is shown as an ellipse, the axes being 18″ and 14″ long. On May 23 this ellipse, otherwise uniformly dense, showed a condensation of 6″ diameter at its N.E. extremity, but this had disappeared on May 24. The nebulosity surrounding the nucleus showed changes from one day to another, and on May 24 recalled that surrounding the Pleiades star Maia.

THE SPECTROSCOPIC BINARY β AURIGÆ.—In No. 22, vol. i., of the Publications of the Allegheny Observatory Mr. R. H. Baker discusses at length the observations of β Aurigæ as a spectroscopic binary. Since the duplex character of this star was announced by Miss Maury in 1889, many observations have been made at Harvard, Potsdam, Pulkowa, and Allegheny in an endeavour to remove certain apparent anomalies from the observed orbit. Assuming that the period was 3·9838 days, Miss Maury found, from the discussion of some 200 plates taken at Harvard, that there was an apparent reciprocal variation of intensity between the two components, but Mr. Baker now shows that this is not so; owing to the assumed period being slightly in error, the two components were alternately misidentified. The discussion of the Allegheny observations with those previously published shows that the orbit is practically circular ($e = 0·0 \pm 0·0057$), and that there is probably a slight variation in the period, amounting to 0·000010 day, or 0·86s. per annum. The period now given is 3·960027 days $+ 0·000010t \pm 0·000004$ days, the present elements being referred to the epoch 1905 September 11·7324, G.M.T.

An investigation of the secondary oscillation found by some observers is not confirmed, nor was Mr. Baker able to find evidence for the dispersion of light during its passage through space from β Aurigæ to the earth.

THE BRIGHTNESS OF THE SKY.—Commenting upon M. Fabry's recent determination of the brightness of the sky, Mr. Gavin Burns brings together, in No. 422 of the *Observatory*, the results obtained by various observers; they are as follows, each value being the brightness of one square degree of non-galactic sky expressed in terms of a fifth-magnitude star:—Newcomb, 1·15; Burns, 2; Townley, 2; Yntema, 5·76; Fabry, 1·46. Mr. Burns remarks that if, as seems probable, the brightness is a variable quantity, the results obtained by different observers are bound to vary considerably *inter se*.

THE ACCURACY OF RADIAL-VELOCITY DETERMINATIONS.—In No. 4, vol. xxxi., of the *Astrophysical Journal* Prof. Frost issues a timely warning against attributing too great an accuracy to present-day determination of radial velocities. A tabulation of twelve values recently obtained by various observers for Arcturus, a simple problem, shows that they vary between −3·7 km. and −6·6 km., whilst the extreme range for any one observer varies from 1·2 km. to 4·5 km. Prof. Frost questions if we know the radial velocity of any star to the nearest kilometre.

MARS DURING THE RECENT OPPOSITION.

So far as can be judged from those yet published, the results accruing from the observations of Mars made during the opposition of 1909 are, in a sense, disappointing. The favourable conditions of the opposition, as regards the altitude and the apparent diameter of the planet, engendered the hope, in many minds, that most of the outstanding problems in the Martian enigma would be solved more or less definitely. Yet the camps into which areographers are divided are still at issue, and the differences appear to be at least as sharply accentuated as before. To the one side the *canali* are still continuous channels, set out with a rectitude more or less geometrical, and having "oases" around the reservoirs upon which they appear to converge; but to the opposition these clearly cut channels are but alignments of dark spots merged into apparent continuity by a physiological illusion.

However, many of the larger features are beyond dispute, and many valuable observations of their appearances and changes have been made since July last. One very remarkable phenomenon was noted, and has been discussed by practically every observer, viz. the apparent veiling of the planet's surface during the earlier part of the opposition.

In June, July, and August the details, and even some of the larger features, were not discernible; there was a general lack of contrast between the light and the dark areas. Thus M. Antoniadi, using the 24-cm. refractor at Juvisy, reported (*Bull. de la Soc. astron. de France*, September, 1909, p. 386) that, on August 11 and 12, the surface of Mars was hardly recognisable, and it was with great difficulty that he assured himself that it was the region of the Mer de Sablier on which he was looking. M. Jarry Desloges also emphasised the unusual appearance of the planet, which he illustrated (*Comptes rendus*, vol. cxlix., No. 17, p. 666) by two charts (Fig. 1), on one of which M. Fournier had recorded the features seen during June, July, and part of August, whilst the other showed the increased contrast of the same features later in August and during September.

It was not until the beginning of the latter month that the accustomed contrasts and details completely reasserted themselves and permitted the work of confirmation and discovery to proceed normally.

M. Antoniadi suggests that this masking effect was caused by the interposition of light, cirrus cloud in th planet's atmosphere, such cloud being filmy in structu and yellowish in colour, so that it reduced the usual co trasts without totally obscuring the features. This is i accordance with Prof. W. H. Pickering's observations i 1895, when he found that his photographs suggested som such yellow screen.

The importance of the acknowledged existence of clou must not be lost sight of in the discussion as to the aqueo

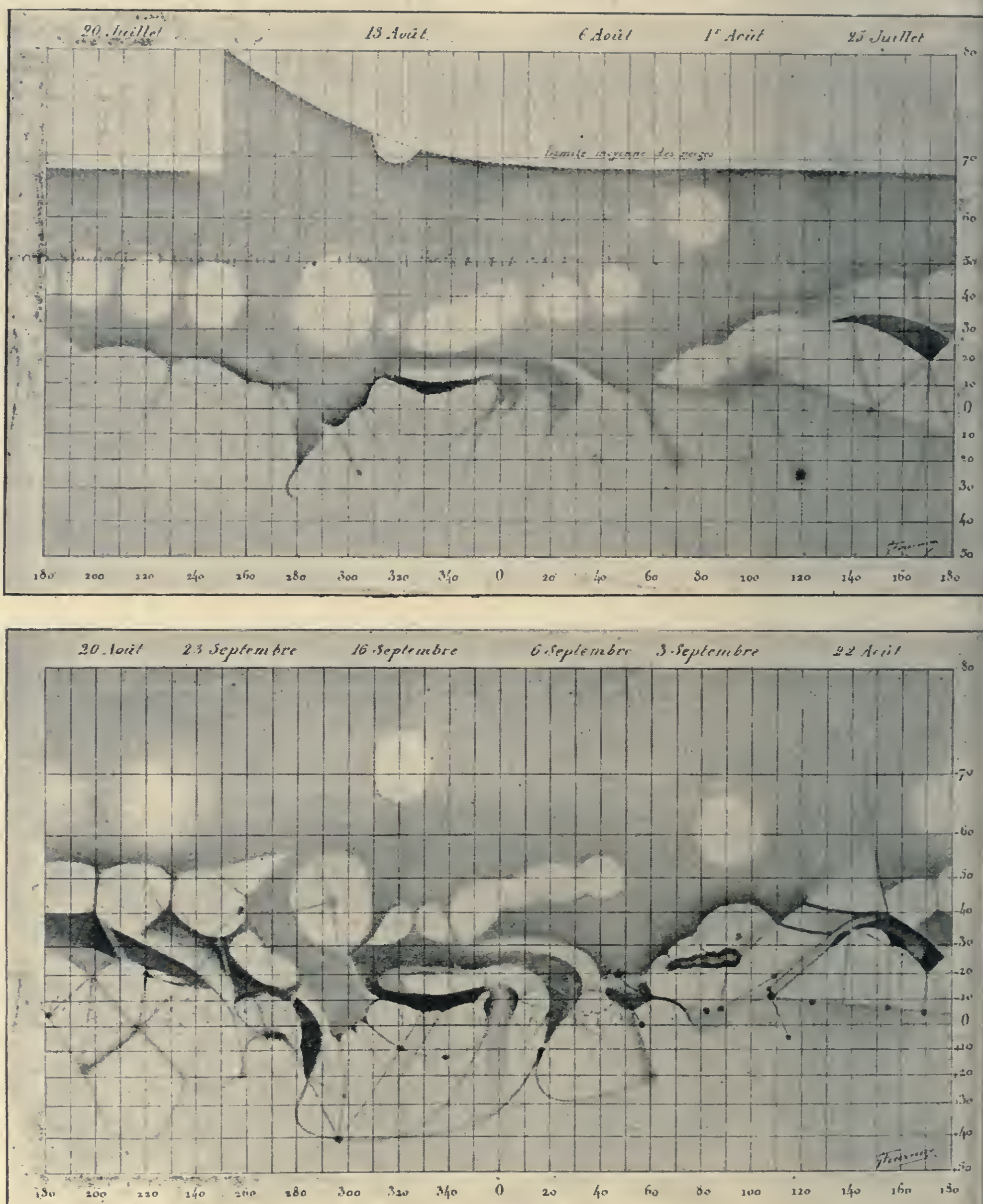


Fig. 1.—Comparison of the appearance of the surface of Mars on different dates in 1909.

contents of the planetary atmosphere. The observations of Beer and Mädler, Secchi, Lockyer, Denning and others, of apparent changes caused by clouds have been generally accepted as strong evidence for the existence of the cloud-producing compound of our own atmosphere.

Turning now to the actual observations of features, and their modifications, during the recent opposition, we find

FIG. 2.—Changes in the southern polar cap of Mars.

that the diminution and transfiguration of the southern polar cap was recognised quite early in the season.

M. Jarry Desloges, observing with a 29-cm. refractor at Massegros (Lozère), recorded (*Astronomische Nachrichten*, No. 4340) a dark cutting—shown on the first drawing in Fig. 2—in longitude 190° on June 20–23, and at the Revard station Lowell's crevasse in long. 350° was easily seen, cutting right through the cap. A large and brilliant spot near the edge of the cap, in long. 30°, was also seen on July 4. The progressive diminution in size and the changes in form, as observed by M. G. Fournier at the Revard Observatory, are shown in Fig. 2, reproduced from a note by M. Desloges (*Comptes rendus*, No. 26, vol. cxlix., p. 1347), who remarks on the increased rate of diminution about August 15, and suggests that the variations in detail and the time of disappearance are probably indications of inequalities in the relief of the polar areas.

M. R. Jonckheere, observing with a 14-inch refractor at the Hem Observatory (Roubaix), also directs attention to this feature. On August 12 he observed (*Astronomische Nachrichten*, No. 4354, p. 159) a "land" become detached from the cap, although itself still covered with ice, and identified it as Schiaparelli's Novissima Thyle. On these grounds he suggests (*Comptes rendus*, No. 22, vol. cxlix., p. 970) that the "lands" remain covered with ice much longer than do the "seas," thus producing apparently irregular variations in the measured diameters of the cap; when, by the planet's rotation, such an ice-covered "land" is brought to the extremity of the apparent ellipse, the major axis will appear to be longer than when the "land" is carried further round. M. Jonckheere's measures of the cap show the following progression:—July 16, 32° (Martian arc); August 15, 18°; September 17, 9·3°; October 18, 11·8°; November 18, 10·2°. On September 2, Argyre II. was seen, and its position determined as long. 60°, lat. −80°; this is nearer the pole than it has hitherto been placed, and M. Jonckheere deduces, generally, that the latitudes ascribed to the polar lands are usually too small. Another mass was seen, on the same evening, in long. 120°, lat. −84°, which apparently had not been recorded before, and to this M. Jonckheere gives the name "Stella," on account of its brightness. "Thaumas" is the name given to another new land which suddenly appeared in the Aonius Sinus, touching Thaumasia, long. 100°, lat. −43°.

According to Prof. Lowell (*Astronomische Nachrichten*, No. 4371, p. 47), the first snowfall of the season in the Martian antarctic region took place on November 17—about two months after the summer solstice—when two

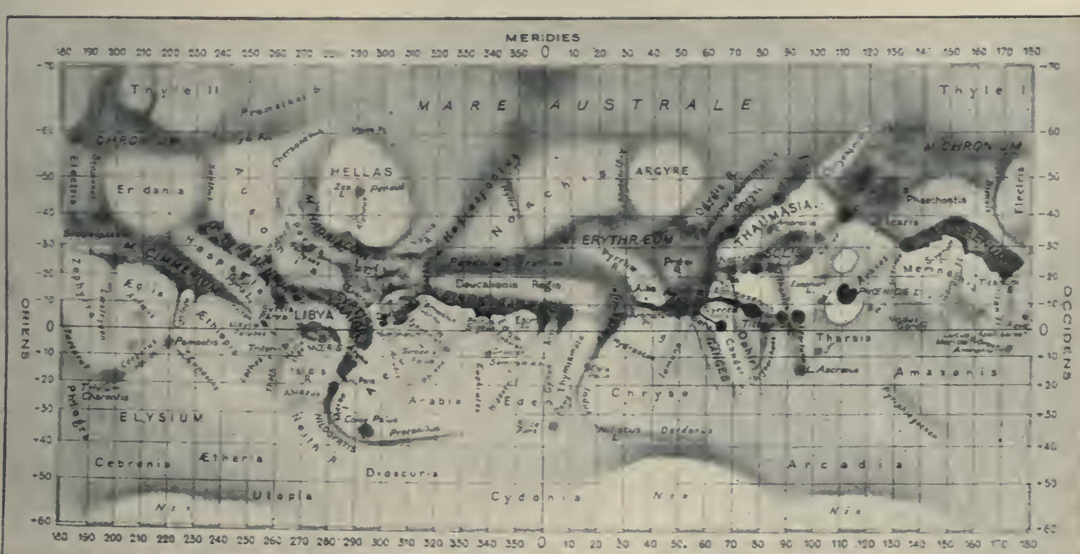


FIG. 3.—Chart of Mars as observed by M. Antoniadi.

patches in latitude −65° were seen in longitudes 100° and 190°.

M. Antoniadi also made observations, at the invitation of M. Deslandres, with the 33-inch refractor of the Meudon Observatory, the third largest refractor in general use. He observed on thirty nights between September 20 and November 9, but on about five nights only were the atmospheric conditions really good. The results of his

observations are shown in the chart here reproduced (*Comptes rendus*, vol. cxlix., No. 20, p. 837), Fig. 3. The most noticeable change since 1907 was in the Syrtis Major, which he found had returned to its form of 1864 and 1877. The Lac Mœris, too, had reappeared as a large, indefinite dark patch, and a multiple island was seen in the eastern part of the Mare Cimmerium.

The Solis Lacus region also presented many striking features, and, among others, M. J. Comas Sola devoted special attention to it (*Bull. de la Soc. astron. de France*, November, 1909, p. 497). In his opinion, the recent opposition "peut être considérée comme la déroute définitive du *réseaux géométrique* des canaux."

It is in regard to these all-important "canali" that the battle of observers rages most intensely. Among European observers, at least, there appears to be consensus of opinion that the term should be used in a more restricted sense, or should only be employed as a generic term embracing several species. There is too great a diversity between the broad, persistent, half-tone patches and the narrow, evanescent streaks, glimpsed for one fraction of a second to be lost the next, for them all to be grouped under the one designation. M. Antoniadi strongly insists on this point (*Comptes rendus*, vol. cxlix., No. 20, p. 836), and classifies eight varieties. Even then he does not include the fugitive right lines, visible only for the fraction of a second, which he considers may be illusions; but he very definitely negatives the existence of any geometrical *réseaux*, of which he finds no trace. At intervals of exceptionally good seeing he sees considerable structure, visible for several consecutive seconds, on the continental areas, and this he describes as "a grey irregular marbling, complex and cloudy, such as only an artist could render."

The Rev. T. E. R. Phillips, observing at Ashtead with his 12-inch Calver reflector, was led to substantially the same conclusions (the *Observatory*, No. 416, p. 463) as M. Antoniadi regarding the canals.

The necessity for the classification of these features is also advanced by M. Desloges, who suggests (*Comptes rendus*, vol. cxlix., No. 17, p. 664) three species, and also directs attention to numerous changes observed during this opposition. The fine *canaux* of his third class were apparently the most affected by the seasonal changes, and M. Desloges finds it difficult to disbelieve their objective existence; one argument advanced in its favour is that they all appear to start in small gulfs, just as the broad, indubitable, dark bands, of the first and second classes, generally have their origins in the larger gulfs.

An encouraging feature of the opposition, which in future developments may lead to a settlement of this vexed question of "objective" and "subjective" phenomena, is the advance made by photography in the recording of the planet's markings. On Prof. Hale's striking photographs (Monthly Notices, vol. lxx., No. 2, p. 175) the contrast between the dark and light areas is remarkable, the bolder features standing out with a distinctness usually seen only on carefully prepared drawings.

Results of great interest were also obtained by MM. de la Baume Pluvinel and Baldet (*Comptes rendus*, vol. cxlix., No. 20, p. 838) at the Pic du Midi Observatory, where the conditions are especially favourable for such observations. The observers intend to make a detailed study of the 1350 images recorded on their set of eighty plates, but, from a brief survey, they are able to state that anyone conversant with Martian topography would immediately recognise nearly all the features observed visually. The canals of the first order, the broader bands such as the Indus, the Ganges, Araxes, Cyclops, Euphrates, &c., are all recognisable, but there is no trace of the geometrical network of fine canals recorded visually by many observers.

Whilst in London recently, Prof. Lowell pointed out that while many of the recent photographs form striking pictures by reason of their strong contrasts in the large areas, the treatment which brings out these contrasts is not that calculated to show also the finer details.

Thus the evidence for the actual existence of the canaliform "canals" is still "mixed." A number of experienced, careful observers still proclaim, with no lack of decision, that they exist; others just as emphatically state that they are, at the most, but the physiological integration of the elements of a mosaic groundwork which covers the planet. Prof. Frost states that the 40-inch refractor at Yerkes is "too powerful" to show them, and Prof. Hale refers to Prof. Barnard's description of 1894 (Monthly Notices, vol. lvi., No. 4, p. 166, 1896) as describing exactly what he sees with the 60-inch reflector at Mount Wilson.

This question of aperture is not a simple one. Thus Prof. Lowell has repeatedly stated that a large aperture is not infrequently a positive barrier to the seeing of such fine details as occur on planetary discs. Attached to his 24-inch refractor he has a system of diaphragms, and the first operation in making an observation is to determine what aperture is most suitable for the conditions obtaining at the moment. A similar procedure was followed by Dawes, whose observations in the 'sixties of last century did so much to forward areography. When discussing the work with Sir Norman Lockyer—who also, at that time, was making valuable drawings of Mars—Dawes repeatedly referred to the conditions of seeing as "a 5-inch night" or "a 6-inch night," &c. Asked for an explanation, he stated that he often found it necessary to reduce his aperture, which normally was 8 inches.

We also learn from Sir Norman Lockyer that when his drawings were discussed at the Royal Astronomical Society, some doubt was expressed because some of the details shown thereon were not shown on the drawings made at the same epoch by the observer using Lord Rosse's reflector; yet when the Leyden drawings arrived, later, these details were confirmed.

Thus Prof. Frost's somewhat enigmatical statement may, logically, be understood to convey a meaning other than that which has generally been ascribed to it, and the failure of the 60-inch reflector to show the straight, hard, sharp lines may not be conclusive evidence of their non-existence.

So far, the employment of the photographic plate has not provided the hoped-for solution of this special question, because the exposures necessary are too long. Each image on the plate is an integration, the moments of fine seeing are overlaid by periods of tremor, and, by their very nature, *fine* lines would be the first to disappear; it is a case where negative evidence is of little value. Nor does it seem logical to say that these lines do not exist because their appearance can be explained otherwise—physiologically, for instance. Their recognition in the same positions by independent observers, at different times, points to the existence of some material objects, and their changes with the change of season exclude the proposition that they are completely solid markings. Even the suggestion that they are alignments of darker spots does not *prove* that they are disconnected items. In desert areas the streams dry up, leaving "water holes"—apparently disconnected if viewed from a great distance—and these holes are surrounded by vegetation throughout the dry season, becoming, therefore, isolated objects; but the river bed is there, and in due season—as on Mars—is filled with water and edged by vegetation.

But their great size, their prolific distribution, and their rectilinear character, even when seen away from the planet's central meridian, are phenomena which are difficult to explain in the case of the Martian canals; and the problem yet remains.

A suggestion made by Dr. Aitken, of the Lick Observatory, might possibly solve this vexed question to some extent. Prof. Lowell's unanswerable argument is that, as the "canals" are so near the limit of vision, it is only in the very finest atmosphere that they can be seen. All observers agree as to the first part of this statement, and Dr. Aitken suggests that the second part might be put to the test by arranging that such experienced protagonists as Prof. W. H. Pickering, M. Antoniadi, and Prof. Barnard should foregather at the Flagstaff Observatory and, with Prof. Lowell, observe Mars during the next favourable opposition. The 24-inch refractor is, as Prof. Lowell has demonstrated, a superb instrument, and for astronomical observations of this character the Arizona atmospheric conditions are unexcelled. The suggestion is a most excellent one, and, could the arrangements be made, the meeting would no doubt lead to an illumination of what, at present, is a very obscure problem.

There are some problems in astronomy which seem to be indeterminate. First, we get a positive solution in one

direction, and then appears the amendment, which is a direct negative; as an example one might cite the rotation periods of the inner planets; but one that is nearer to the present question is the problem as to the spectroscopic evidence for the existence of water vapour in Mars.

Since Huggins compared the Martian and lunar spectra in 1867, a number of observers have made similar observations under various conditions, and with contradictory results. The summarised history of the research is given by Prof. Campbell in a recent Bulletin (No. 169) from the Lick Observatory, and the majority of the conclusions are in favour of the presence of water-vapour bands; whether the conclusions were supported by the evidence, when adequately analysed, is the question. Observations made at Mount Hamilton in 1894 demonstrated to him that, to obtain satisfactory evidence, they should be repeated at an altitude sufficient to escape the greatest possible proportion of the terrestrial atmospheric effects, and, to this end, he examined the conditions obtaining on the summit of Mount Whitney, the highest point in the United States, in 1908. The preliminary survey satisfied Prof. Campbell as to the atmospheric conditions, and he decided that, if the necessary money could be obtained for shelters and equipment, an expedition from the Lick Observatory should take advantage of the favourable opposition of 1909 to carry the research a step further. As is usual in, and, one might say, peculiar to, America, funds were forthcoming, with the result that, at the end of August, 1909, the summit of the mountain was occupied by an especially equipped expedition ready to take spectrograms when the conditions of Mars and the moon were favourable.

FIG. 4.—Temporary Observatory on Mount Whitney, for the investigation of water-vapour in the atmosphere of Mars.

Such spectrograms, six in number, were secured on the nights of September 1 and 2, and it is to the discussion of the evidence afforded by these that Bulletin No. 169 is devoted. This evidence does not appear to be positively conclusive, but Prof. Campbell deduces "that the quantity of any water vapour existing in the equatorial atmosphere of Mars at the time these observations were made was too slight to be detected by present spectrographic methods. . . . it is difficult to conceive that the quantity of vapour above unit area on Mars could exceed or equal the quantity of terrestrial vapour above the same area of Mount Whitney."

It should be remarked here that the altitude of the summit of Mount Whitney is 14,501 feet, and, according to Hann's empirical formula, 0·79 of the terrestrial water vapour would be below. A photograph of the shelter and part of the equipment is reproduced, from the Journal of the Royal Astronomical Society of Canada, in Fig. 4.

Prof. Campbell expressly states that it is not contended that Mars has *no* water vapour, and that polar caps composed of hoar-frost, demanding a small quantity of vapour, would probably not be out of harmony with his observations. In Bulletin No. 43 of the Lowell Observatory Mr. Abbot's report is quoted to the effect that he and Prof. Campbell were on Mount Whitney during unusually unfavourable weather, under conditions which would probably not be met with at that season one year in ten. This is important, because, no matter how much of the theoretical water-vapour content of the terrestrial atmosphere was left below, it is absolute evidence that water vapour was present, in quantity, above.

The Mount Whitney plates, at the most, only afford negative evidence, and it is not contended that they do more. Thus the question of water vapour becomes one of amount rather than of existence or non-existence, and its settlement is rather academic than practical. There is no doubt as to the difficulty of securing absolute evidence—so many variables have to be eliminated before the sought-for residual is attained.

But, as stated above, the question is now generally accepted as settled in favour of the presence of water vapour in the Martian atmosphere. The darker edge of the melting "snow" caps, the proved existence of clouds, and the changes of intensity and shape of many features, point definitely to the existence of a fluid material, and, without any violent assumptions, to that fluid being water. We note that Prof. Campbell suggests that the observed yellowish colour of the clouds may indicate for them some other chemical compound than H_2O, but, if this is so, should not the spectrum of Mars indicate some other absorption which is not mentioned?

WILLIAM E. ROLSTON.

THE RESEARCH DEFENCE SOCIETY.

THE annual meeting of the Research Defence Society was held on Friday, June 3, at the Royal College of Physicians, and was very largely attended. The chair was taken by the Earl of Cromer, president of the society. The other speakers were the Hon. Sydney Holland, chairman of committee, Sir Richard Douglas Powell, Sir David Bruce, Mr. Anthony Hope Hawkins, and Mrs. Scharlieb. The work and the literature of the society are by this time well known to the public, and the annual report shows a great increase in the membership and in the extent of the work.

Perhaps, of all the speeches, the most interesting was Sir David Bruce's account of his observations on the African sleeping sickness and other African diseases. In 1903 it had been hard or impossible to persuade the Uganda chiefs that the sleeping sickness is carried by the tsetse-fly. "But these same so-called uncivilised natives, whose untutored minds could not perhaps at once grasp the position, a few years later were so convinced of the truth of what we told them that they cleared the lake-shore and islands of their inhabitants, with the result that, so far as I am aware, at present not a single new case of sleeping sickness is being contracted in Uganda proper, and the toll of human lives to this plague has ceased to be paid. This toll has been estimated at 200,000 out of a population of 300,000. In one island alone, Buvuma, with a population of 32,000, 18,000 are reported to have perished." From this fact Sir David Bruce went on to speak of experiments which had shown how long the fly, once infective, may remain infective, and of the question of the infectivity of animals. Then he referred to a disease which destroys 70 to 80 per cent. of the calves born in Uganda; the cause and the nature of this disease had been discovered by experiments on animals. "By animal experimentation we found out the nature of several of the most important diseases of the

domestic animals in Uganda, and on more than one occasion nipped an epidemic in the bud, thus earning, if they had known it, the gratitude of the animals themselves."

Of no less interest was his account of "muhinyo," a fever among the Uganda natives, which had been mistaken, by clinical observation, for diverse other fevers. The Sleeping Sickness Commission, by animal experimentation, proved it to be, practically, Malta fever, and further proved that the germs of muhinyo were present in some of the goats from an infected district. The evidence thus appears complete that the fever, like Malta fever, might be transmitted in the goat's milk.

Finally, Sir David Bruce spoke of the discovery that the common sand-fly is capable of transmitting simple continued fever. Here the experiments were made on volunteers in the cause of science. "The study of the habits of the sand-fly is being pursued with energy, and I hope that within a short time simple continued fever will have disappeared as completely from Malta as Malta fever has done." Of the completeness of the disappearance of Malta fever from our army in Malta, since the goat's milk was prohibited, the following figures are proof:—in 1905 there were 643 cases; in 1906, 147; in 1907, 11; in 1908, 5; in 1909, 1; and in 1910, thus far, 0.

We hope that the Research Defence Society will see to it that such a record of the experimental study of diseases shall not be allowed to drop out of the public mind.

METEORIC FIREBALL OF JUNE 1.

ONE of those brilliant meteors which often appear in the twilight of our midsummer skies was seen on Wednesday, June 1, at 9.40 p.m. The atmosphere was fairly clear, and the object formed a fine spectacle to many persons in the southern counties of England. Excellent descriptions of the apparent path it traversed have come in from various places, including Coventry, Bristol, Cheshunt (Herts), and Ealing, Sydenham, and Herne Hill, London.

The meteor was much more brilliant than Jupiter, and as it sailed slowly along it apparently changed its colour from electric blue to gold, and threw off a short trail of reddish sparks. Viewed from the metropolis, the observed flight was a descending one from west to north-west, and the whole trajectory occupied about four seconds.

There is no doubt that the meteor was directed from a radiant near Antares, in Scorpio, which has furnished many June fireballs in past years. Its height was from about 62 to 48 miles, and the path of some 100 miles, traversed at a velocity of about 25 miles per second. First visibly appearing over a point near Chippenham, it passed to north-west, crossing the Severn, and disappearing south of Montgomery, in Wales. Other reports will doubtless come to hand, and enable this result to be tested, but it cannot be far wrong. The fireball supplies further corroboration of the activity of the Scorpiid shower, and of the almost unique brilliancy of its meteors. There was a fireball seen in Scotland by several observers on May 24, at 11h., and this had a height of about 70 to 44 miles over the sea north of Ireland. This object also was directed straight from the radiant in Scorpio.

W. F. DENNING.

INTERNATIONAL CONGRESS ON TROPICAL AGRICULTURE AND COLONIAL DEVELOPMENT.

A NOTE on the organisation of this congress was published in NATURE of April 7, and it is only necessary to say now that the congress was arranged by the International Association of Colonial Agriculture, with the assistance of the Belgian Society for the Study of Tropical Agriculture. British contributions to the congress were provided for by a British committee, including agricultural and forestry officials throughout the Empire, and of which Prof. Wyndham Dunstan, F.R.S., was president, and Dr. T. A. Henry secretary.

The congress met from May 20 to May 23 in the Palais de Congrès of the Brussels Exhibition. The date of the first meeting coincided with the funeral of the late King, so that the president, Colonel Thys, merely declared the congress open, and the meeting was adjourned as a mark of respect to the memory of His late Majesty.

The work of the congress was divided into three sections, (1) dealing with agriculture and forestry; (2) with animal industries; and (3) with labour, transport, and trade. Altogether nearly 200 reports and papers were presented to the congress, and of these more than one-third were submitted through the British committee. It is only possible to refer briefly to a few of the more important matters discussed.

In July, 1909, the International Association appointed "General-Reporters" to collect information on various subjects connected with tropical agriculture, and to present reports on them to the congress, and the reading and discussion of these reports occupied much of the time devoted to sectional meetings.

Prof. Dunstan submitted a general report on the practical results of cotton cultivation in various countries, with observations on the scientific and economic causes of its success or failure. He pointed out that the successful development of cotton cultivation in West Africa and other suitable territories in the future will depend on the establishment of a variety of cotton suited to the country and to the requirements of manufacturers, and that this can best be achieved by persistent scientific work carried on by Government. The position of cotton cultivation in the United States, Egypt, India, and other producing countries was then reviewed. Prof. Dunstan also presented special reports from countries in which cotton cultivation is carried on commercially or experimentally, each of these recounting the difficulties met with and the experimental work in progress in the area considered. These reports were contributed by authorities on cotton cultivation in each of the countries dealt with.

A similar inquiry on the rubber plants of tropical countries resulted in the presentation of a number of reports, each of which dealt with the rubber plants, native or introduced, of the country considered, the methods of obtaining rubber therefrom, and, in most cases, the improvements needed in native methods of preparation. Reports from the following countries were submitted:—Belgian Congo (MM. Kindt, Pynaert, and Ghislain), French West Africa (M. Yves Henry), British West Africa (Mr. H. Brown), British East Africa (Mr. A. C. Macdonald), German African colonies (Dr. Warburg), Java and Sumatra (Prof. Berkhout), Mexico (Señor Flores), Brazil (Señor Argolo), &c. Special papers were also contributed by Dr. Heim (Rational study of rubber plants) and Prof. Carmody (New method of preparing Castilloa rubber).

Other inquiries undertaken were the place of botanic gardens in agricultural research in the tropics, and legislation against the spread of insect pests and fungoid diseases; but comparatively little progress was made with these, though special reports in connection with the first-named were submitted by M. Capus for Indo-China, and by Profs. A. Engler and G. Volkens, of Berlin.

Apart from these reports, many papers were submitted on more general subjects. Mr. A. E. Humphries read a useful paper on the wheat requirements of the United Kingdom, in which he outlined the characters which millers in this country seek in imported wheat. Mr. I. B. Pole Evans described the results of investigations undertaken in the Transvaal with a view to the development of rust-resistant cereals, and Mr. Guthrie, of New South Wales, submitted two papers, one describing chemical investigations in connection with the production of improved wheat, and the other giving an account of the work of the late W. J. Farrer, who initiated wheat-breeding work in New South Wales. Only two papers on tobacco were submitted, one by Mr. Odlum, of Rhodesia, describing the cultivation of bright pipe tobacco, and the other by Drs. Henry and Auld on the burning quality of tobacco, in which they pointed out that defective burning quality is one of the first difficulties met with in growing tobacco in a new country, and showed, as the result of numerous analyses of tobacco ash, that good burning depends on the nature and quantity of mineral constituents in the leaf, and

eventually, therefore, on the composition of the soluble components of the soil and the manures applied. Mr. R. N. Lyne presented a paper on the causes contributing to the success of the Zanzibar clove industry, in which the importance of soil and climate in this connection was insisted on, and not less the success of the Arab proprietors of the plantations in accommodating their business methods to the habits of the native population.

Dr. S. S. Pickles submitted a paper in which the characters and composition of the essential oils obtained from a large number of Cymbopogon grasses grown in Ceylon were given. These results are of great importance in connection with Dr. Stapf's recent botanical revision of this genus.

In section 2 the principal topic of discussion was the essential factors in the acclimatisation of European cattle in the tropics, on which useful reports were submitted by M. Meuleman, who is General-Reporter for this inquiry, M. Douarche, of Tonquin, M. Peralta for Costa Rica, Mr. Jarvis for Rhodesia, and Prof. Carmody for Trinidad. The only general paper read in this section was one by Mr. Barwick, of the Imperial Institute, on African wild silks.

The papers submitted in section 3 were of economic and administrative importance rather than of scientific interest, though reference may be made to the reports, mainly by officials in British colonies, submitted by M. Batalha-Reis on agricultural labour conditions in the tropics.

During the congress a special meeting of the International Association of Colonial Agriculture was held, at which Prof. Wyndham Dunstan, director of the Imperial Institute, was elected president of the association in succession to M. de Lanessan, formerly Governor of Indo-China, who had held this office since the foundation of the association in 1905.

INDIAN PALÆONTOLOGY.

THE Geological Survey of India continues to publish well-illustrated and exhaustive memoirs on the fossil invertebrate faunas of the region with which it deals. Two more on the Himalayan Trias have lately appeared, and are of much interest for study in connection with recent work on the Triassic fossils of other areas. The first memoir (*Palaeontologia Indica*, ser. 15, vol. vi., No. 1, 1909), on the Lower Triassic Cephalopoda from Spiti, Malla Johar, and Byans, was begun several years ago by the late A. von Krafft, who collected much of the material. It has now been revised, completed, and brought up to date by Prof. C. Diener. It begins with a synopsis of the marine Lower Triassic formations of the Himalayas, which are proved to constitute a remarkably complete series. The detailed descriptions of the fossils which follow show that at least four distinct and successive faunas occur in the rocks of the district under consideration. Of these, the lowest or earliest is perhaps the most interesting, because it seems to represent the dawn of Triassic life in the sea. It is noteworthy for the complete absence of the numerous types of Palæozoic Brachiopoda, which are the predominating element in the Permian rocks of the Salt Range and the Himalayas. Both in the Alps and in the Himalayas the Permian and Trias are connected by an uninterrupted sequence of sedimentary deposits. The second memoir, by Prof. Diener (*loc. cit.*, No. 2), is more special, treating of the fauna, chiefly Cephalopoda, of the Thaumatocrinus Limestone of Painkhanda. He returns to a discussion of the age of this limestone, and shows that enough of its ammonites are identical with (or closely allied to) species found in Europe to justify its correlation with the Julic horizon, or zone of *Trachyceras aonoides*.

Another memoir just received from the Geological Survey of India, though dated 1908, contains a valuable description of the Devonian faunas of the northern Shan States, by Mr. F. R. Cowper Reed (*Palaeontologia Indica*, N.S., vol. ii., No. 5). The fossils are chiefly corals, Bryozoa, and Brachiopoda, with only few representatives of other groups, but they constitute the richest collection of Devonian age hitherto described from south-eastern Asia. Most of them were obtained from Padaukpin, and many appear to be identical with European species which characterise the lower part of the Middle Devonian. The marine faunas of Middle and Upper Devonian times prove to have been remarkably cosmopolitan; but in all cases, as at Padaukpin and other places in eastern Asia, there is also a local element giving them a special character.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. H. Rastall, of Christ's College, has been appointed additional demonstrator in geology from June 1, 1910, to May 31, 1915.

The electors to the Frank Smart studentship in botany give notice that they will shortly proceed to the election of a student. Any graduate of the university is eligible for the studentship, provided that not more than fourteen complete terms have elapsed after his first term of residence. The successful candidate must devote himself to research in botany under the direction of the professor of botany. The studentship is ordinarily tenable for two years. The student is in special cases eligible for re-appointment for a third year; he may be appointed for one year only. The value of the studentship is 100*l*. per annum. A candidate must send his name, with a statement of the course of research which he proposes to undertake, and such evidence of his qualifications as he thinks fit, to the Vice-Chancellor, Pembroke College Lodge, on or before Tuesday, June 21.

OXFORD.—In a convocation held on Tuesday afternoon, June 7, in the Sheldonian Theatre, the Chancellor of the University, Lord Curzon of Kedleston, presiding, the honorary degree of D.C.L. was conferred on ex-President Roosevelt, who then proceeded to deliver the Romanes lecture. Taking as the subject of his discourse "Biological Analogies in History," Mr. Roosevelt enlarged upon the phenomena of the rise and extinction of species, especially instancing the history of the mammalian fauna of South America from the Eocene epoch onwards, and drawing parallels between the changes taking place in the course of evolution among the lower animals, and the vicissitudes of human political societies. The treatment of the subject was interesting and suggestive, and the lecturer met with a cordial reception.

A TELEGRAM from the *Times* Ottawa correspondent on June 2 announced that a commission has been appointed by Federal authority to investigate the need for technical education in Canada. Mr. J. W. Robertson, late principal of the McDonald Agricultural College, has been appointed chairman of the commission.

THE current issue of the *Battersea Polytechnic Magazine* is a double number, with an unusually varied and interesting table of contents. Instances are given in one of the articles of the lively interest shown by King George and the late King in the work of the polytechnic. Among other contributions are an account of Brennan's monorail, and the biological disposal of sewage. The reports of the doings of the clubs and societies of the polytechnic are good evidence of the activity of the institution.

BY the will of the late Mr. Isaac C. Wyman, of Salem, Mass., a graduate of Princeton College, who died on May 18 last, most of his estate, says *Science*, is bequeathed to Princeton University. The daily papers estimate the value of the bequest to be from 400,000*l*. to 2,000,000*l*. From the same source we learn that the Jefferson Medical College of Philadelphia has received a gift of 12,000*l*. from Mrs. M. G. Horwitz, daughter of the late Prof. S. D. Gross, to endow the "Samuel D. Gross Chair of Surgery."

THE fifth issue of the "Girls' School Year Book (Public Schools)" is now available, and it may be remarked that the annual is, for the first time, the official book of reference of the Association of Head Mistresses. The book continues to be useful, providing parents, schoolmistresses, and girls themselves, as it does, with trustworthy information respecting secondary education for girls. The second part of the work deals chiefly with the future career of girls on leaving school, and will appeal specially to parents and guardians, since the particulars given are of a thoroughly practical nature.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 2.—Sir Archibald Geikie, K.C.B., president, in the chair.—L. S. **Dudgeon**, P. N. **Panton**, and H. A. F. **Wilson**: The influence of bacterial endotoxins on phagocytosis (preliminary report). Extracts were prepared from most of the common pathogenic organisms by grinding them up in the presence of sterile sand or glass, and adding a definite amount of sterile salt solution; this was then centrifugalised at high speed, and the final supernatant layer employed as the endotoxin. *The Action of the Endotoxic Substance on the Leucocytes.*—The authors' experiments, although limited, failed to indicate that there was any direct action on the leucocytes, as in no instance was there any appreciable variance from the control experiments. *The Action of the Endotoxic Substance on the Serum.*—The following facts were evident as a result of these experiments:—(1) that the endotoxic substance was capable of exerting a *specific action* on the serum in a large proportion of cases; (2) that the endotoxic substance was unaffected by heat; (3) that dilution of the endotoxic substance correspondingly diminished its toxic effect upon the serum, but in a few instances, when diluted, it appeared to play the part of "stimulin," so that the degree of phagocytosis was far greater than in the control experiments.—Prof. H. E. **Armstrong** and E. Frankland **Armstrong**: The origin of osmotic effects. III.—The function of hormones in stimulating enzymic change in relation to narcosis and the phenomena of degenerative and regenerative change in living structures. When a leaf of cherry-laurel is exposed to the vapour of an anæsthetic, hydrogen cyanide is at once liberated; as this is easily detected by means of Guignard's sodium-picrate paper, the liberation of the cyanide affords a delicate indication of the occurrence of enzymic change in the leaf. Not only the common anæsthetics, but most organic vapours, appear to act as excitants, *e.g.* toluene, volatile alcohols, and especially ethereal salts of acids of the acetic series. Ammonia is very active, and it is noteworthy that even carbon dioxide, hydrogen cyanide, and benzaldehyde condition the breakdown of the cyanophoric glucoside in laurel leaves. When solutions are used, it is found that weak solutions of mineral acids, alkalies, and most salts are inactive, but the simpler organic acids, mercuric chloride, cadmium iodide and sodium and potassium fluorides all pass into the leaf from solutions. Apparently, the behaviour of the laurel leaf resembles very closely that of the barley grain (*cf.* Adrian J. Brown, Roy. Soc. Proc., B, 1909, vol. lxxxi., p. 82). It is proposed to divide substances other than colloids into two subclasses, according as they will or will not pass through differential septa such as occur in the barley grain and the laurel leaf; also to apply to the former the term *hormone* introduced by Starling. The change brought about by hormones may be attributed largely, but not entirely, to the influence they exercise in causing alterations in concentration of the fluids within the leaf. Experiments are adduced showing that water actually passes into the leaf, together with the hormone; also that not only is hydrogen cyanide liberated and water absorbed, but that the amount of reducing sugar in the leaf is increased. The hypothesis is advanced that when substances which are not attractive to water are introduced into the living cell they exercise stimulative effects that are primarily mechanical, molecules of the hormone being interposed between the molecules in the cell and the activity of the medium raised by the change in the osmotic state, so that a flux of water from other regions takes place. Possibly the mere dilution thus effected is determinative of change; contact being established between hydrolyte and hydrolyst, degenerative changes are set up which tend to increase in intensity as the products of change in turn exercise a similar stimulative influence; gradually enzymes are set free which can attack the various hydrolytes stored in the cell. The phenomena of change in living structures, especially muscle and nerve tissue, are considered from this point of view; also the phenomena of narcosis, the regulation of respiration, and the physiological effect of alcohol and of drugs generally. It is pointed out, also, that the hypothesis may afford an explanation of a number of more recent observations on plant metabolism. Partially sterilised soils, for example, which Russell has shown to be so fertile, are rich both in carbon dioxide and ammonia: it is suggested that these are two factors of prime importance as stimulants of plant growth; for a similar reason, sulphate of ammonia may have special value in comparison with other nitrogenous fertilisers. The deleterious effect of grass growing over the roots of fruit trees may be more or less due to the removal, which the grass effects, of ammonia, and the consequent withdrawal of the stimulus which this hormone affords to the roots of the trees.—Dr. R. D. **Kleeman**: The direction of motion of an electron ejected from an atom by ultra-violet light. Experiments were carried out to see whether the kathode radiation from substances exposed to ultra-violet light moves initially in the direction of propagation of the light. The amount of kathode radiation from a platinum film deposited on a quartz plate in a discharge tube was measured with the film facing the source of ultra-violet light, and with it facing in the opposite direction. It was found that if the intensity of the pencil of light used is denoted by unity, the intensity of the light after passing through the quartz plate and film is 0·55; and if we denote by unity the intensity of the kathode radiation from the film when it faces the source of light, the intensity of the radiation when the film faces in the opposite direction is 1·15. Since the intensity of the light decreases as it passes through the quartz plate and platinum film, it follows that the larger leak in the latter case than in the former would not be obtained if the kathode rays were ejected equally in all directions, but might occur if they have a component in the direction of propagation of the light.—Sir William **Crookes**: Scandium, part ii. This is a continuation of the paper read in April, 1908, in which, after describing the mode of extracting scandia from the mineral wiikite, the principal salts, twenty-three in number, were described, their formulæ and analytical results being given in detail. The scandia used in the preparation of some of the salts now described was not absolutely pure. Chemically, no other earth could be detected in it, but the spectrograph revealed traces of yttria and ytterbia. These traces could have been removed by one or more operations, but the author thought it advisable to leave them in, for the following reasons: in each operation of purification some loss is unavoidably incurred, and when chemical reactions are insufficient to find the other earths it is not worth diminishing his lessening stock of scandia for the sake of academic purity. The chief reason, however, for leaving these traces in is that they might afford evidence of a difference of behaviour between one earth and another in the presence of some of the acids used. After each quantitative determination the scandia was dissolved in acid, and a spectrogram taken to see if yttria or ytterbia were present. The residual earth was then collected from the mother-liquor, and a photograph taken of its spectrum. A comparison of the pair of spectra shows at once if any separation has been effected between the earths present. When separation is apparent, further experimentation on a larger scale is reserved to a future occasion. The following salts are described, and details of their analyses given:—scandium borate, scandium mono-chloroacetate, scandium lactate, scandium fumarate, scandium $\alpha\beta$-dibromopropionate, scandium citrate, scandium orthochlorobenzoate, scandium metanitrobenzoate, scandium phthalate, scandium tetrachlorophthalate, scandium 2-nitrophenyl-4′-tolylamine-4-sulphonate, and scandium octamethyltetraminodihydroxyparadixanthylbenzenetetracarboxylate. More than once the author has been asked why he chose such out-of-the-way acids wherewith to prepare scandium salts. He gives his chief reason. Attempts on several occasions have been made to discover a means of separating some of the "rare earths" from their companions by forming compounds with weak organic acids. Thus, in 1897, Kosmann employed citric acid in the separation of thoria. Urbain used acetylacetonate of sodium for the same purpose. Metzger tried maleic acid, cinnamic acid, picric acid, phthalic acid, and fumaric acid. In 1904 Neish tried many organic acids for the separation of the rare earths, chiefly thoria. Among other acids he tried gallic, tannic, citric, salicylic, oleic, linoleic, paratoluic, oxyisophthalic, benzoic, meta-, ortho-, and para-nitrobenzoic, and fumaric. Of

these, metanitrobenzoic acid proved most effectual, the process being capable of accurate quantitative results. Soon after those experimental papers appeared the author commenced similar researches, hoping to find an organic reagent which would be a precipitant for some of the yttria earths—if not with quantitative accuracy, at all events with sufficient separation to allow a fractionation method to be based on the reaction. His results, not being sufficiently definite, were never published; but as the organic acids were in his laboratory when the scandium research was commenced, he preferred to use these acids, of which the purity and the history were known, rather than start afresh with acids of unknown history.—J. **Eustice**: Flow of water in curved pipes. Experiments were made on a flexible tube with the object of ascertaining the increased resistance to the flow of water which is due to the curvilinear motion of the water in coils of uniform radius. The tube, which was about 0·37 cm. internal diameter in its normal condition, was sufficiently small to admit readily of experiments both below and above the critical velocity. In order to separate the effect of curvature and change of cross-section, special apparatus was employed to change the section of the straight tube from circular to oval form. Comparisons were made between the flow in the straight tube and the flow in the tube when it was coiled, the straight tube and the coiled tube being of the same form and area of section. The results obtained show that:—(*a*) The flow in a straight flexible tube of circular section follows the laws of flow in metal tubes as investigated by Prof. Osborne Reynolds, and that the velocity at which turbulence commences is given by Reynolds's formula. (*b*) The critical velocity, which is so well marked in the flow in a straight tube, appears to be entirely absent when the tube is coiled, that is to say, the index law for straight tubes does not hold for coiled tubes. (*c*) The increased resistance due to the curvature of the tube length is represented by the formula $(\Delta V/V)^n = CR^{-1}$, where ΔV is the loss of velocity due to coiling the tube, V is the velocity in a straight tube of the same form and area of section, R is the radius of the coil, and C is a constant for any given velocity V, but both *n* and C vary with V.—Prof. A. **Dendy** and G. E. **Nicholls**: The occurrence of a "mesocœlic recess" in the human brain and its relation to the sub-commissural organ of lower vertebrates, with special reference to the distribution of Reissner's fibre in the vertebrate series and its possible function. The authors find in the adult human brain a small cavity, lined by a characteristic columnar epithelium, imbedded in the roof of the *iter* at the back of the posterior commissure, and in close relation to this another irregular cavity, which apparently represents the remains of a communication with the lumen of the *iter*. In the five months' fœtus this communication is still widely open, and the cavity in question is evidently part of a structure lying beneath the posterior commissure, and corresponding to the so-called "ependymal groove" of lower vertebrates. For this structure the authors now propose the more distinctive term "sub-commissural organ." It consists, in the human fœtus, of two bands of high columnar epithelium with deeply situated nuclei, invaginated posteriorly into the roof of the *iter* to form a "mesocœlic recess," as in certain lower vertebrates. In the adult man it is in a vestigial condition, being represented by the mesocœlic recess alone. In the chimpanzee the sub-commissural organ is better developed than in man, and the mesocœlic recess still opens into the lumen of the *iter* in the adult, the recess itself having a diameter nearly ten times as great as in the human subject. The condition of the sub-commissural organ in the cat and the mouse is also described and figured for purposes of comparison. In these two types it is very well developed, and there is also a Reissner's fibre. The latter, in the cat (and probably also in the mouse), breaks up into slender branches, which are connected with the modified epithelium of the sub-commissural organ, exactly as in lower vertebrates (*e.g.* lamprey, frog). Considering this well-defined relation of Reissner's fibre to the sub-commissural organ, it seems highly improbable that in man, where the sub-commissural organ is reduced to a mere vestige altogether shut off from the remainder of the cavity of the brain, a Reissner's fibre exists. It is maintained that these observations support the view already put forward that Reissner's fibre has a mechanical and not a nervous function, and that, in connection with the sub-commissural organ, it forms an apparatus for automatically regulating (in lower types) the flexure of the vertebral column; this function is supposed to have become obsolete with the assumption of the erect position and the loss of the tail.

Zoological Society, May 24.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—D. G. **Lillie**: Observations on the anatomy and general biology of some members of the larger Cetacea. This paper was the outcome of seven weeks spent at the Irish whaling station during the summer of 1909. The object of the visit was to make a preliminary survey of the opportunities which are now offered for a study of the larger Cetacea by the recent establishment of whaling stations off the shores of the British Isles. A list was given of the species captured at the Irish station during the two years of its existence, with notes on the species *Balaenoptera musculus*, Linn., *B. sibbaldii*, Gray, and *Physcter macrocephalus*, Linn., which were seen by the author. The paper also contained observations on the occurrence of hairs in whales, the auditory organ of the Balænoptera, the asymmetry of the odontocete skull, and a few remarks upon the habits of whales. In conclusion, attention was directed to the present difficulty in obtaining information as to their method of copulation, period of gestation, rate of breeding, &c., and a means of overcoming this difficulty was suggested.—C. F. **Rousselet**: Collection of rotifera made by the third Tanganyika expedition, 1904–5. Amongst the specimens brought back by Dr. W. A. Cunnington were a number of tubes containing fine surface plankton nettings from Tanganyika and other lakes of that region. These the author searched for rotifera, and the result was contained in the present paper. From Lake Tanganyika only eleven species were obtained, all already known in other parts of the world, whilst the River Lofu, which enters the lake at its south-western corner, yielded twenty-three species, one of which is a very remarkable new kind. In Lake Nyassa only six species were found, and a single gathering of Victoria Nyanza yielded nine species. This collection is interesting and important from the fact that no previous record of rotifera from Lake Tanganyika had been made, and very few species were known from the Central African region.—J. **Ritchie**: (1) The hydroids of the Mergui Archipelago, collected by Mr. J. J. Simpson and Dr. R. N. Rudmose Brown; (2) the hydroids of Christmas Island, collected by Dr. C. W. Andrews, F.R.S. The chief interest of these two papers was faunistic. In the former thirty species were recorded, in the latter thirteen. It was apparent that the hydroid fauna of the eastern Indian Ocean, of which hitherto little had been known, lacked distinctness, and that its closest affinities were with the faunas of the neighbouring Malay Archipelago and Australian areas.

Institution of Mining and Metallurgy, May 26.—Mr. Edgar Taylor, president, in the chair.—T. J. **Hoover**: A standard series of screens for laboratory testing. This paper represents an attempt on the part of the author to reconcile the conflicting elements in the existing series of screens, such as the "common" series, Rittinger's, Richards's, De Kalbs's, and the I.M.M. Standard Screens, and to present in their place a "cube root" series, for which he claims merits hitherto wanting; also to present a practical mechanical method of making screen analyses. With these ends in view, after a brief reference to the functions required in laboratory screening, the author proceeds to analyse in detail the various series of screens mentioned, and of his proposed substitute, and to compare them with silk bolting cloth. Subsequently he directs attention to a machine calculated to simplify the operation usually accomplished by means of hand-sizing tests. An ample bibliography concludes the paper.—H. **Stadler**: Grading analyses and their application. This paper gives in detail the results of a number of tests made by the Mines Trials Committee in South Africa, from which the author proceeds to show how the various portions of certain standard sizes of particles may be valued in units of energy which will allow of an exact expression of the efficiency of the crushing operation for purposes of useful comparison. He claims that the most rational and logical system of

classification into grades is undoubtedly to base it on the reduction of the volume or weight of the particles, and for this purpose he reduces the cube of the unit successively by one half its volume, thus obtaining a reduction scale in the "common" ratio of 2, or by eliminating alternate grades preferably in the ratio of 1/4. The scheme does not standardise the screens as such, but establishes an unerring standard for the sizing and classifying of the screen products into grades, and is consequently valid for screens of any description, independent of purely practical and commercial considerations. An examination of the practical application of grading analyses follows, and, as a result of the trials made, the author states that investigators are now in a position to determine with a comparatively high degree of accuracy the relative merits of different crushing appliances or the mechanical efficiency of one and the same machine working under varying conditions.—T. A. **Rickard**: Standardisation of English in technical literature. The author protests against the corruption of the English language, and pleads for more exact definition in technical literature. He deals in detail with various aspects of the subject, giving examples of the faults to which he makes objection, as, for instance, "spurious" words adopted from other callings, vulgarisms or slang terms, and the practice of giving variable meanings to words, all these tending to destroy the proper significance of language, and so enfeebling it. Objection is taken to the use of the "unnecessary" plural in such words as slimes, sands, concentrates, middlings, tailings, &c.

CAMBRIDGE.

Philosophical Society, May 23.—Dr. Fenton, vice-president, in the chair.—Prof. **Pope** and J. **Read**: The resolution of externally compensated bases into their optically active components.—Prof. **Pope** and C. S. **Gibson**: The resolution of dihydropapaverine.—Dr. **Sell**: Further study of the products of chlorination of α-picoline.—Dr. **Fenton** and W. A. R. **Wilks**: Formation of uric acid derivatives.—C. T. **Heycock**: Water of crystallisation in calcium phosphate.—S. **Ruhemann**: (1) The diketopyrrolines and their analogues; (2) the formation of α- and γ-pyrones from acetylenic acids.—H. O. **Jones** and J. K. **Matthews**: The reduction of nitrosyl chloride.—W. A. R. **Wilks**: Absorption of bromine by lime.—F. **Robinson**: Note on the absorption of acids by carbohydrates.—Sir George **Greenhill**: A hollow vortex in a polygon.—R. T. **Beatty**: A dissymmetry in the emission of kathode particles excited by homogeneous Röntgen radiation. Homogeneous radiations were allowed to pass through a thin silver leaf, and the ionisation due to kathode particles emitted from the leaf on the emergent and incident side respectively was measured. On allowing for the absorption of the homogeneous radiation in the leaf, this ionisation was greater on the emergent side; and this dissymmetry, while but slight for soft radiation, increased with the hardness. The same values for the dissymmetry were found when a copper leaf was substituted for the silver leaf. The results show that the dissymmetry is unaltered whether much homogeneous radiation be excited in the leaf or not.—J. A. **Crowther**: Note on the transmission of β rays. The author has recently shown that the absorption of a beam of homogeneous β rays by aluminium follows a law approximating to that lately suggested by Sir J. J. Thomson. The absorption of such a beam in platinum, however, follows an exponential law. This result is ascribed to secondary β radiation excited in the platinum. It is now further shown that the absorption by aluminium of a pencil of homogeneous β rays, after transmission through a small thickness (0·001 mm.) of platinum, is also exponential, resembling the absorption law obtained for the rays from a single radio-active substance.—A. Ll. **Hughes**: The mobilities of the ions produced in air by ultra-violet light. The experiments show that air is ionised by ultra-violet light of very short wave-length. The mobilities of the ions so produced are found to be identical with the mobilities of the ions produced by X-rays.

MANCHESTER.

Literary and Philosophical Society, May 3.—Mr. Francis Jones, president, in the chair.—H. **Sidebottom**: Report on the recent Foraminifera from the Bay of Palermo, Sicily. A special account was given of the genus Lagena, which comprises many very elegant flask and decanter-shaped chambers. Some of the members of this genus adhere together at their bases in clusters of three or more, and others show the peculiarity of having two or three slender necks instead of the normal one. Examples of these clusters were shown under the microscope, and many beautiful drawings were exhibited.—C. **Bailey**: A third list of the adventitious vegetation of the sandhills of St. Annes-on-the-Sea, North Lancashire, Vice County 60.—H. **Bateman**: The physical aspect of time. The point of view adopted was that our ideas of space and time were part of our interpretation of the processes of electromagnetism, and were purely relative inasmuch as any measurement of them involved some properties peculiar to the mode of measurement. The transition from one interpretation to another must depend upon a transformation which leaves the fundamental equations of electromagnetism unaltered in form. A brief discussion of the nature of these transformations may be based upon a consideration of the conditions which must be satisfied in order that at a given time an observer may be in a position to witness an event which occurred at some other point at a given previous time. A transformation may be compared to a translation of a poem from one language to another; the words may be different in the two cases, but the ideas are the same. It is somewhat similar in the case of two different interpretations of the same electromagnetic process.

DUBLIN.

Royal Dublin Society, May 24.—Prof. Sydney Young, F.R.S., in the chair.—R. J. **Moss**: An improved method of milk analysis. The milk is dried on tinfoil, which is then rolled up, and the fat is extracted in a Soxhlet apparatus. The non-fatty solids are dried at 100° C. in a vacuum with the aid of sulphuric acid. These solids are obtained in a form suitable for further examination. The process occupies from three to four hours.—Prof. W. **Brown**: Magnetism and torsion in iron, in which some results were given for iron wire of different degrees of hardness, and when under different longitudinal loads.—Prof. J. **Wilson**: The separate inheritance of quantity and quality in cows' milk. The author made use of the recently published report of the milk-testing scheme carried out among Ayrshire cattle in 1908. There were more than 8000 cows tested; but, in order to have a fair comparison, all under four years old, and all that had milked for less than thirty or more than forty weeks, were eliminated. That left about 3000 cows. When these were divided into four groups, viz. those giving less than 500 gallons of milk, those giving from 500 to 600 gallons, those giving from 600 to 700 gallons, and those giving more than 700 gallons, it was found that the qualities of the milk given by all the cows in all groups was the same; that is to say, of the numbers of cows giving all the various qualities of milk, from that containing about 2·7 per cent. of fat up to that containing about 5·5 per cent., the resulting curve starts at zero near 2·7, rises to a maximum of about 3·6, and declines again to zero near 5·5 per cent., and exactly similar curves were given by the cows in the other three groups. The author infers that the proportion of fat in a cow's milk is unconnected with the yield.

PARIS.

Academy of Sciences, May 30.—M. Émile Picard in the chair.—The president announced the losses sustained by the academy by the deaths of Robert Koch and Sir William Huggins.—E. **Bouty**: The dielectric cohesion of neon and its mixtures. The dielectric cohesion of neon is very low in comparison with that of other gases, and upon this fact is based a delicate quantitative method for measuring the amounts of impurities in neon. Mixtures of neon with carbon dioxide and air were studied, the increase of the cohesion due to the addition of either of the latter gases being somewhat greater than that calculated from the ordinary mixture law.—Armand **Gautier**: Some remarks, from the geological and chemical point of view, relating to the action of heat upon carbon monoxide. Experiments are described which lead the author to the conclusion that at a temperature of 1300° C., and at the ordinary pressure, carbon monoxide in porcelain tubes, and in the absence of organic matter and of metal, undergoes no sensible dissociation, and no carbon is set free.—A. **Lacroix**: The

optical properties of the holocrystalline phosphorites of Quercy.—A. **Müntz**: The struggle for water between living organisms and natural media. Different soils require different amounts of water for saturation, and if the water actually held is under the saturation figure no water can be absorbed by a seed, and no germination takes place. Several cases are considered at length.—Albert, **Prince of Monaco**: The twelfth scientific campaign of the *Princesse Alice*, and also the oceanographic work of the Monaco Museum.—M. **de Forcrand**: The heat of formation of cæsium peroxide. A thermochemical study of the solution of cæsium peroxide in water and dilute acids.—Lecoq **de Boisbaudran**: Can the truffle be replanted? The separation from the mycelium hinders the growth of the truffle, but does not altogether stop it.—M. Pérez was elected a correspondant for the section of anatomy and zoology in the place of the late M. Lortet.—Emile **Marchand**: Phenomena observed at the Pic du Midi on May 18–19 (passage of Halley's comet across the sun). From the whole of the observations no clear conclusion can be drawn as regards the possible electric action of the cometary material.—K. **Popoff**: Observations of Halley's comet made at the Observatory of Sofia, Bulgaria, May 18, 1910.—D. **Eginitis**: Observations of Halley's comet made at the Observatory of Athens. The changing aspect of the tail is discussed from the point of view of its curvature and the change in the curvature on approaching the sun. No sign of the comet was visible as it crossed the sun's disc.—Jules **Baillaud** and G. **Demetresco**: Photographic observations of Halley's comet at the Paris Observatory. The conditions were unfavourable, photographs being possible on May 23, 24, and 28 only.—P. E. **Gau**: The search for the intermediate integrals of the equation $s=f(x, y, z, p, q)$.—S. **Lattès**: Taylor's series with recurring coefficients.—J. **Le Roux**: The distribution of torsion in the infinitesimal deformation of a continuous medium.—H. **Larose**: Two sets of solutions of the equation of telegraphists.—W. **Duane** and A. **Laborde**: Quantitative measurements of the radium emanation. The relation between the initial value of the saturation current due to the presence of a given amount of the radium emanation, the interior surface and volume of the condenser given by W. Duane in 1905 has been confirmed, and the constants in the equation re-determined. When these constants are known for a given condenser, a single determination of the initial saturation current is sufficient to determine the amount of radium emanation present.—L. **Boutan** and J. **Feytaud**: Stereoscopic colour photography and its scientific applications. The arrangement described permits the use of artificial light; photographs in colour of a medusa and of a branch of coral were made.—Maurice **de Broglie**: The electrification of the air by the carbon monoxide flame and by the radium rays; comparison of the mobilities of the ions present in the two cases. The ions liberated by chemical action and high temperature in the combustion of carbon monoxide and those which are produced by the radium rays have very similar mobilities, and are probably identical.—M. **Driot**: Some six zinc oxychlorides have been described, but by the direct action of zinc oxide upon solutions of zinc chloride only two distinct substances have been indicated, according to the author's experiments. These are

$$ZnCl_2,4ZnO,6H_2O \text{ and } ZnCl_2,ZnO,1{\cdot}5H_2O.$$

—Gustave **Vavon**: The rotatory power of pinene hydrochloride. The results given are in complete accord with the hypothesis first put forward by Semmler, and developed by Ahlström and by Aschan, according to which the α and β pinenes give the same solid hydrochloride. The yields furnished by the two hydrocarbons are the same.—P. L. **Viguier**: α-Bromocrotonic aldehyde. Crotonaldehyde is treated with bromine, and then the product distilled with a solution of sodium acetate. From the distillate the bromocrotonic aldehyde can be isolated. The yield is not very good, about 25 per cent., but the method is rapid. The oxidation and condensation of the bromaldehyde with malonic acid is described.—Fr. **Reverdin**: A trinitro-p-anisidine.—L. **Tchougaeff** and W. **Fomin**: Some cholesterin derivatives. Two cholesterylenes have been prepared by heating methyl cholesterylxanthogenate, and formulæ given for the constitution of these hydrocarbons.—Paul **Becquerel**: Experimental researches on the latent life of the spores of Mucorineæ and Ascomycetes.—J. E. **Abelous** and E. **Bardier**: The influence of bleeding on the resistance of animals to urohypotensine.—M. **Lioret**: The transformation of phonograph traces into curves.—L. **Cuénot** and L. **Mercier**: Studies on the cancer of mice. Heredity and sensibility to cancerous grafting.—Pierre **Girard**: The electrostatic mechanism of the semi-permeability of living tissues to electrolytes.—J. **Chaine**: Spinal curvature.—Armand **Dehorne**: The number of chromosomes in batrachians and in the parthenogenetic larvæ of the frog.—Jules **Courmont**, Th. **Nogier**, and M. **Rochaix**: Does water sterilised by the ultra-violet rays contain hydrogen peroxide? The sterilising power of hydrogen peroxide. The first question is answered in the negative, and it is shown that considerable proportions of hydrogen peroxide acting for some hours are not equivalent to the sterilising power of ultra-violet light acting for a few minutes only.—L. **Fortineau**: The curative treatment of anthrax by pyocyanase. The injection of pyocyanase has a curative effect on malignant pustule.—A. **Besredka**: A means of avoiding anaphylactic accidents.—Marcellin **Boule** and R. **Anthony**: The encephalus of the fossil man of La Chapelle-aux-Saints.—Fr. **de Zeltner**: The decorated grottos of the French Soudan.—A. **Quidor**: Protandry in the Lernœopodidæ.—Louis **Gentil**: The Tertiary movements in the Moroccan Haut-Atlas.

NEW SOUTH WALES.

Linnean Society, March 30.—Mr. C. Hedley, president, in the chair.—C. **Hedley**: Presidential address. The submarine slope of New South Wales. (1) *The Notonectian Current*.—Past Sydney there flows south a warm and rapid current well known to sailors and fishermen. Neither its origin nor its conclusion has been satisfactorily determined. Two recent maps give contradictory views of its course. It has been assumed, rather than proved, that this current is derived from the south equatorial current, the path of which, after encountering the Melanesian Islands, is indefinite. The investigation of this current is the largest, most fruitful, and fascinating problem within the reach of the Sydney marine biologist. (2) *The Continental Shelf*.—The continental shelf may be defined as that area extending outwards from the land to a depth of about one hundred fathoms. This distinction is not arbitrary, for at or about this point the sediment alters to finer, and the slope of the sea-floor to steeper. These features indicate the approaching limit of sediment. Wherever the profile of the New South Wales coast be examined, a terrace is found to project from the beach to the hundred-fathom line, whence the ground quickly changes to a steeper grade. Compared with most other coasts, the continental shelf is here exceptionally narrow, resembling in this respect that of western South America. Off Cape Dromedary the shelf contracts to a dozen miles, and off Newcastle it broadens to thirty-four. This narrowness of the shelf renders it impossible that extensive trawling grounds may be discovered in the waters of the State. It is now suggested that the continental shelf of New South Wales owes its profile to the Notonectian current. (3) *The Continental Base*.—In illustration of the slope below the shelf, here termed the continental base, a profile is selected extending seventy miles east-south-east of Ulladulla, and produced backwards to include the coast range. Without excluding faulting as a minor agent, it is suggested that the whole sweep of the diagram portrays an earth-fold of the first magnitude—*that it represents the further wall of a pressure-trough driven by a thrust from the east*, a gigantic buckle which is bending down the whole eastern coast of Australia. If so, it must be a component of a vast system. The uniform and recent subsidence which extends from Torres Strait to Tasmania is in harmony with this suggestion.—Dr. R. **Greig-Smith**: The slime of the household bath-sponge. The formation of slime is due to the action of bacteria attacking spongin, the chief constituent of the sponge, and producing a slime. One of those which produced the phenomenon in experimental sponges is described. The slime contains one of the galactan class of gums.—Dr. R. **Greig-Smith**: The bacterial flora of rachitic stools.

April 27.—Mr. C. Hedley, president, in the chair.—E. J. **Goddard**: Contribution to a knowledge of Australian

Hirudinea, part v., leech-metamerism.—E. J. **Goddard**: Contribution to a knowledge of Australian Hirudinea, part vi., the distribution of Hirudinea, with special reference to Australian forms, and remarks on their affinities, together with reflections on zoogeography.—H. J. **Carter**: Revision of the genera Sympetes and Helæus, with descriptions of new species of Tenebrionidæ.

CALCUTTA.

Asiatic Society of Bengal, May 4.—A. C. **Sen**: "The fight for the cows" in the Rigveda. The prevailing opinion is that "the fight for the cows by the Angirases," mentioned in the Rigveda, is a highly anthropomorphosed description of the monsoon storm in the Panjab. The author of the paper has tried to prove that the story refers to an actual fight for cows between two people, the Indo-Aryans, commanded by their king *Trita*, and a non-Aryan people called the *Panis*, under the leadership of their chief Vala.—Rev. H. **Hosten**: Who planned the Táj? The subject has come up for discussion several times of late years. Mr. Havell, in particular, is of opinion that the Italian or French origin of the Táj cannot be held. The present paper advocates a return to the traditional view, and offers the contemporary evidence of Friar Sebastian Manrigue (1670) to show that Sháh Jahán approved of the plans of Jerome Verones, a Venetian architect. Mr. H. G. Keene in his "Turks in India" and his "Handbook of Agra" had come to the same conclusion from a study of Manrigue. His conclusion has been set aside. A full translation of Manrigue's Spanish account is now presented, and it is hoped that the evidence will be found satisfactory.

DIARY OF SOCIETIES.

THURSDAY, JUNE 9.

ROYAL SOCIETY, at 4.30.—The Distribution of Velocity in the β-Rays from a Radio-active Substance: J. A. Gray.—The Decrease of Velocity of the β-Particles on Passing through Matter: W. Wilson.—Rate of Emission of α-Particles from Uranium and its Products: J. N. Brown.—The Accumulation of Helium in Geological Time. IV.: Prof. The Hon. R. J. Strutt, F.R.S.—The Effect of Small Traces of Water Vapour on the Velocities of Ions produced by Röntgen Rays: R. T. Lattey.—On the Variation with Temperature of the Viscosities of the Gases of the Argon Group: Dr. A. O. Rankine.—The Effect of Pressure upon Arc Spectra. Part II., No. 4. Gold: Dr. W. G. Duffield.—On Radiation in a Gaseous Explosion: Prof. B. Hopkinson, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—(1) A New Method in the Theory of Integration; (2) On Semi-integrals and Oscillating Successions of Functions: Dr. W. H. Young.—The Composition of Finite Screw Displacements: G. T. Bennett.—Note on the Theory of Linear Differential Equations: Prof. M. J. M. Hill.—The Generation of Cubic Curves by Apolar Pencils of Lines: W. P. Milne.—On Geiser's Method for the Bitangents of a Plane Quartic Curve: Miss M. Long.—The Transformation of the Equations of the Theory of Electrons for Quasi-stationary Motion: H. R. Hassé.

ROYAL INSTITUTION, at 3.—Malaria: Major Ronald Ross, F.R.S.

FRIDAY, JUNE 10.

ROYAL INSTITUTION, at 9.—The Progressive Disclosure of the Entire Atmosphere of the Sun (in French): Dr. H. Deslandres.

PHYSICAL SOCIETY, at 8.—A Galvanometer for Alternate Current Circuits: Dr. W. E. Sumpner and W. C. S. Phillips.—The Positive Electrification due to Heating Aluminium Phosphate: A. E. Garrett.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Photographs of Nebulæ made with the 60-inch Reflector of the Mount Wilson Observatory: G. W. Ritchey.—Note on Sodium in Comets' Tails: T. W. Backhouse.—Remarks on Mr. Backhouse's Paper: A. Fowler.—The Long-period Variable V Cassiopeiæ: A. N. Brown.—Note on a Paper on Periodic Orbits: Sir G. H. Darwin.—Quantitative Applications of Radiation Pressure to Cosmic Problems: A. F. and F. A. Lindemann.—The Systematic Motions of the Bradley Stars: S. S. Hough and J. Halm.—Results of Micrometer Measures of Double Stars made in 1909: Royal Observatory, Greenwich.

MALACOLOGICAL SOCIETY, at 8.—A Revision of the Species of the Family Pyramidellidæ occurring in the Persian Gulf, Gulf of Oman, and the North Arabian Sea: Dr. J. Cosmo Melvill.—The Anatomy of *Hemiplecta foullioyi* from New Guinea: R. H. Burne.—Further Notes on the Dates of Issue of Sowerby's "Conchological Illustrations": A. Reynell.

SATURDAY, JUNE 11.

ROYAL INSTITUTION, at 3.—Electric Heating and Pyrometry: Prof. J. A. Fleming, F.R.S.

MONDAY, JUNE 13.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Land of the Incas: Sir Clements R. Markham, K.C.B., F.R.S.

TUESDAY, JUNE 14.

ZOOLOGICAL SOCIETY, at 8.30.—On the Cutaneous Scent-glands of Ruminants: R. I. Pocock.—(1) On a Pair of Wapiti Antlers and a new Muntjac; (2) On Three African Buffaloes: R. Lydekker.—On Two New Antelopes: A. Cabrera.—The Plumage of the Grouse: Dr. E. A. Wilson.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Ekoi of Southern Nigeria: P. A. Talbot.

WEDNESDAY, JUNE 15.

GEOLOGICAL SOCIETY, at 8.—The Natural Classification of Igneous Rocks: Dr. Whitman Cross.—The Denudation of the Western End of the Weald: H. Bury.—An Earthquake Model: Dr. J. W. Evans.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Alcyonarians collected by Sir Ernest Shackleton's Antarctic Expedition: The President.—On the Resolution of New Detail in a *Coscinodiscus asteromphalus*: E. M. Nelson.—Note on the Use of the Mercury Vapour Lamp in Observing the Rings and Brushes in Crystals: E. B. Stringer.—New Fine-adjustment for Body and Substage of Microscopes: E. B. Miller-Williams.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—England—Abyssinia—the South Atlantic: a Meteorological Triangle: J. I. Craig.

THURSDAY, JUNE 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Experimental Researches on Vegetable Assimilation and Respiration. VI. Some Experiments on Assimilation in the Open Air: D. Thoday.—A Case of Sleeping Sickness studied by Precise Enumerative Methods: Regular Periodical Increase of the Parasites Disclosed: Major R. Ross, F.R.S., and David Thomson.—The Recognition of the Individual by Hæmolytic Methods (Preliminary Communication): Dr. Charles Todd and R. G. White.—Receptors and Afferents of the Third, Fourth, and Sixth Cranial Nerves: Miss F. M. Tozer and Prof. C. S. Sherrington, F.R.S.—Trypanosome Diseases of Domestic Animals in Uganda; (1) *Trypanosoma pecorum*: Colonel Sir D. Bruce, F.R.S., and others.—The Lignite of Bovey Tracey: Clement Reid, F.R.S., and Eleanor M. Reid.

LINNEAN SOCIETY, at 8.—Inheritance of Sterility in Potatoes, with Remarks on the Shapes of the Pollen: Dr. Redcliffe N. Salaman.

CONTENTS.

THURSDAY, JUNE 16, 1910.

THE FACE OF THE EARTH.

Das Antlitz der Erde. By Prof. E. Suess. Vol. iii., pt. ii. Pp. iv+789; 3 plates, 5 maps. (Vienna: F. Tempsky; Leipzig: G. Freytag, 1909.)

Namens und Sachregister für Sämtliche Bände. By Dr. L. Waagen. Pp. 158. (Vienna: F. Tempsky; Leipzig: G. Freytag, 1909.) Price, including index vol., 50 marks.

The Face of the Earth. Vol. IV. Translated by H. B. C. Sollas, under the direction of Prof. W. J. Sollas. Pp. viii+673. (Oxford: Clarendon Press, 1909.) Price 25*s.* net.

ALL geologists will join in hearty congratulations to Prof. Suess on the completion of his great work, the influence of which has been spreading steadily since the appearance of its first part in 1883. Prof. Suess's views were opposed to such cherished traditions that they were naturally at first regarded with suspicion; but *many* of his conclusions have been now generally accepted, and his illuminating suggestions have stimulated much fertile research. The last section of the work (vol. iii., part ii.) is accompanied by a series of most valuable maps and a detailed locality index of 158 pages, prepared by Dr. Lukas Waagen. The concluding part shows Prof. Suess's wide acquaintance with the whole literature of stratigraphical geology, which he interprets with characteristic insight and originality. The summary of recent geological work on various remote regions would alone ensure this volume a warm welcome from its usefulness as a work of reference, apart from its place as the completion of one of the standard works in geological literature.

The conclusion has been awaited in the hope that it would be largely devoted to a general summary of Prof. Suess's results and his explanation of the existing plan of the earth. This expectation has, however, not been fulfilled. This part includes the tenth to twenty-seventh chapters of the third volume, and thirteen of the eighteen chapters continue a revision of the mountain systems of the world, dealing with those of Europe, America, Africa, and Oceania. The remaining five chapters discuss various general problems, including the three zones of the earth's crust, which, from the chemical symbols of their leading constituents, Prof. Suess calls Nife, Sima, and Sal, the trend of mountain folds, isostacy, the process of igneous intrusion, the structure of the moon, and a final chapter on some lessons from the distribution of life. There is no attempt at a complete general theory of the distribution of land and water on the earth, as Prof. Suess apparently holds that none such is yet possible. He recognises on the earth several superposed plans, but makes no suggestion as to their causes. Thus the reason for the difference between the Atlantic and Pacific types of coast structure he describes as still unknown, and he leaves "to the future" (p. 724) the explanation of the great marine transgressions, the fundamental importance of which he was the first to appreciate correctly. The explanation that they are due to the shallowing of the ocean basins by the spheroidal recovery of the earth after periods of deformation is not mentioned, though it may once be vaguely alluded to.

The first impression made by a perusal of this volume is the greatness of the changes between it and its predecessors. Prof. Suess's essential principle that the face of the earth owes its expression to dimples and wrinkles due to the earth having shrivelled with age is maintained; but the view that all vertical movements are necessarily downward is abandoned. The ingenious explanations by which Prof. Suess endeavoured to explain away Darwin's evidence as to the vertical uplift of the coast of Chile after the earthquake of 1822 are resigned, in face of the well-established vertical uplifts along the western coasts of North America. Prof. Suess, however, does not admit uniform regional elevation, and he therefore necessarily rejects the principle of isostacy. He discusses this question in one of his final chapters, and expresses his strong distrust of mathematical evidence on such problems. Its uncertainty is illustrated by his proposal to alter the widely accepted conclusions by simply modifying the formula by which they were reached. Suess points out (p. 703) that the omission, as suggested by Faye, of the second factor in the formula used in deducing the weight of the earth's crust from gravity observations would remove the evidence obtained in some cases that the weight of mountains is compensated by a deficiency in material underneath. As the factor in question is a correction for the weight of the material between the point of observation and sea-level, its inclusion seems reasonable. Prof. Suess's further statement that deficiencies in mass beneath mountains "would be contradictory to all geological knowledge" (p. 708) is unexpected, as it is the weight of the geological evidence for the action of isostacy that has induced so many geologists to accept the mathematical arguments in its favour. Less stress is laid in this volume upon variations of the shore line in consequence of local disturbances of sea-level; and Prof. Suess remarks (p. 694) that there is no precise knowledge of the effect of continental attraction upon it. He also changes the meaning of the term batholite, which he proposed for masses of plutonic rocks injected into cavities due to radial contraction; he now attributes the formation of batholites to the replacement of the original rock by absorption and assimilation. Though most geologists are prepared to admit that igneous absorption takes place to some extent, many will probably hesitate before accepting it on so vast a scale.

Some modification was expected in the definition of the Atlantic and Pacific coast types, the establishment of which was one of the great contributions of Prof. Suess's earlier volumes. The Pacific coast type was originally characterised as bounded by mountain chains folded towards the ocean; this view has proved untenable without considerable modifications, and Prof. Suess now accepts (p. 577) the absence of mountain-making activity on the Atlantic coasts as the essential difference; he seems, however, disposed to regard the structural basis of this classification as

less important than the petrographic; he retains the terms for Harker, Becke, and Prior's two petrographic regions, of which the Atlantic is characterised by igneous rocks rich in alkalies, and the Pacific by those rich in lime and magnesia. Both the characters of recent mountain formation and the chemical composition of the lavas can only be applied with numerous exceptions; and we cannot but think it would be regrettable if the great geographical truth in Suess's original view were abandoned, and his two terms retained with a meaning so changed and inappropriate as to be misleading.

Though no general theory is advanced in this volume, Prof. Suess gives in an appendix (pp. 783–5) his final classification of the lands of the earth. He arranges them in the following ten divisions:—

(1) Eurasia, including part of North America; (2) Laurentia; (3) Gondwanaland; (4) Australia, Oceania, and parts of Antarctica; (5) South America and the western mountains of North America; (6) the British Isles, excluding the southern counties, but including part of Norway and the mountains of the western Sahara; (7) the volcanic islands of the Atlantic type, with which are grouped some of the islands of the eastern Pacific, Indian and Southern Oceans; (8–10) the Cape Mountains, the north-western peninsula of New Guinea, and the Fiji Archipelago are each independent elements.

This classification, embodying the conclusions that have been reached by Prof. Suess after thirty years of most careful research, must command respectful consideration from all geographers, though objection may be taken to some parts of it.

The first seven chapters (Nos. x. to xvi.) describe the mountains of western Eurasia, of which the most important are referred to two groups, the Altaids, including the Hercynian Mountains of Bertrand, and the Alpids, formed by Cainozoic foldings in areas that had foundered in the frame of the older Altaids. The Caucasus are now transferred from the Alpine to the Altaid system. There are unquestionably important differences between the Alps and the Caucasus, but these two chains and the Pyrenees were all due to earth movements that probably had a connected origin, though they affected western earlier than eastern Europe. Thus the Pyrenees were folded at the end of the Eocene; the Alps in the Upper Miocene, and the Caucasus in post-Sarmatian times. No doubt the Caucasus has a foundation of older mountains; but so also have the Pyreness, which have indeed a more typical Altaid basis than the Caucasus.

No one can differ from Prof. Suess on mountain classification without great hesitation. But a classification which correlates the Caucasus with the hills of Devonshire instead of with the Pyrenees is obviously not intended for general geographical use. The geological evidence still seems consistent with the conclusion of Fournier, who, in his monograph on the Central Caucasus, reports "que la Caucase, par sa direction, par l'âge et le sens de son dernier plissement, par le parallélisme même des stades de sa formation, est le prolongement direct de la grande chaîne Alpine."

The African representatives of the Altaids include the Atlas Mountains, to the south of which is a mountain band composed of Archean rocks with a north to south strike. From this fact Prof. Suess identifies them as a section of the Caledonian mountains. In Scotland the general trend of the foliation in the gneiss and crystalline schists is not from north to south, which is the direction characteristic of the Archean rocks of equatorial and northern Africa; there seems no very convincing reason for correlating these mountains of the western Sahara with the British rather than with the African Archeans.

The discussion of the Eurasian Mountains closes with an especially valuable chapter, in which Prof. Suess traces the Altaid system through the Appalachians and across the United States as far west as Texas and the frontiers of Mexico. Then follow two chapters, one on the African fractures and the other on the Oceanids, the island festoons of Australasia. In dealing with Australia, Prof. Suess's most important proposal is its separation from Gondwanaland, on the ground that not enough is known of the intervening area to show their relations. The evidence, however, of the fossil flora and fauna of Australia seems conclusive of the former land connection of Australia and Gondwanaland.

Prof. Suess next discusses the western mountains of America, and traces the Asiatic structure into America through Alaska. He re-classifies the mountains of North America, and again, as with the correlation of the Caucasus, appears to attach undue weight to the early history and materials of the mountains in comparison with the movements to which they owe their existing forms and geographic importance. He divides the western mountains of North America into three groups. The eastern group is that of the Rocky Mountains, which Suess shows, by a masterly study of Alaska, belong to the Asiatic Structure. The westernmost group is the Mount St. Elias chain, which passes out into the Pacific through the Alexander Archipelago. All the mountains between the Rockies on the east and the chain of Mount St. Elias, and the Coast Range of California on the west he calls the Intermediate Mountains; they reach the Pacific coast in British Columbia and the northern part of the United States. On the strength, mainly, of these "Intermediate Mountains," Prof. Suess now maintains the essential unity in structure between North and South America, though of the four chief mountain elements in the former only the Intermediate Mountains occur in both. The view of the unity of the two Americas is based partly on these Intermediate Mountains and partly on the Andes, of which the low Archean Coast Range of California is regarded as the northernmost representative. Prof. Suess represents the Andes as formed by pressure from west to east, so that where the movement was not obstructed by the great mass of the Eastern Highlands of South America the Andean line projected eastward in two great loops, the northern Antilles in the West Indian area, and the "Southern Antilles," including Tierra del Fuego, the South Shetlands, and Graham Land. In both these "Antilles" the Pacific is represented as having advanced into the Atlantic region. The writer once

visited the West Indies to investigate this problem, and, in spite of the nature of the lavas, felt bound to reject the conclusion owing to the palæontological and tectonic evidence.

South America itself, according to Prof. Suess's interpretation, has a uniform structure without any trace of the earlier geographical plans which he admits in other continents. The mountains trending from north-west to south-east in the Argentine he explains as connected with the Andes, an opinion different from that of some Argentine geologists; and as it is conceded that the Sierra de Tandil does not belong to the Andes, there seems evidence for the existence of an older mountain system.

The English translation has been issued as vol. iv., without the plates, maps, appendices, and index, which are to follow. The translation shows evidence of haste, and it has missed the revision by several distinguished geologists of which the preceding volume had the benefit. Miss Sollas has done her part of the work well, as the translation reads easily; but in a work of such geographical importance it is a pity that the geographical terms were not more carefully revised. Thus the depressions on the oceanic floors known in German as "Rinnen" are translated as "channels" (p. 294), a term which connotes the idea of flow, so that the term "trench," recommended by the International Geographical Congress, is preferable. "Die Stauung der ersten Welle" (p. 438) is translated (p. 382) as "the stowing of the first wave," whatever that may mean. More serious objection can be taken to the translation of "Das Zwischen Gebirge," in which Prof. Suess includes all the mountains in Canada and the United States west of the Rockies with the exception of the Mount St. Elias chain, as the Intermediate "Range." The term range is so unsuitable to a vast area of mountain country, which includes many mountain ranges, that the translation cannot always adopt it; so when Prof. Suess says (p. 479), "Das Zwischengebirge in ein Meer von submeridionalen Zügen aufgelöst," the English version reads, "The Intermediate *Chain*, broken up into a sea of submeridional *ranges*."

As an illustration of the inconsistency in the translation of geographical terms, it may be remarked that Gebirge, Züg, and Kette are all sometimes translated as range; while Gebirge and Kette are also both sometimes translated as chain. British students will find the irregular treatment of place-names inconvenient and puzzling. Such variations as Brazilia and Brasilia are unimportant, though hardly to be expected in a work issued by a University Press; but many of the variations introduced are confusing. Thus, Prof. Suess speaks of the Sea of Ochot'sch, and calls some adjacent mountains the Ochitiden. The translation, by adopting Okhotsk (p. 328) for the sea and Ochotides for the mountains, obscures their connection; the latter name is once spelt Okhotides. The Yana of p. 331 is the Jana of p. 332; and the Chuchki Peninsula of p. 358 is the Chukchi of p. 377. The Chaja of Suess is sometimes repeated in that form (p. 334), sometimes as Khaja (p. 335), and as Chaya (p. 337). Kegyl (p. 334) is Kygyl on p. 339.

Many of the names in the translation appear in German forms, and are difficult to find in British atlases; thus the lake, which in the *Times* atlas appears as Yege—a reasonable transliteration—is spelt Eche or Essc. Yezo appears as Hokkaido, and Gilolo as Halmahera. The Vistula is mentioned thrice, but its identity is each time concealed by the retention of its German name, Weichsel; "from the Weichsel to Dakota" (p. 88) does not give much information to a student limited to British atlases or gazetteers. Further confusion is added by the differences between the text and the figures; thus Werchne in Fig. 28 is the Verkhne of the text, and Werchojanskij in the same figure occurs as Verkhoiansk in the text.

In the French edition the original technical terms are often quoted in brackets after the translation, and as that excellent precedent has not been followed it would be convenient if, in the index-volume, a list were given of Prof. Suess's geographical terms with the translations adopted. J. W. GREGORY.

EXPLORATIONS OF INDIA.

The Gates of India. Being an Historical Narrative. By Colonel Sir Thomas Holdich, K.C.M.G. Pp. xv+555. (London: Macmillan and Co., Ltd., 1910.) Price 10s. net.

THESE "Gates of India" are the gates beyond the Indus, the difficult tracks through which all the great historic invaders of the country made their way prior to the days of oceanic exploration. There are few men more competent to write about them than Sir Thomas Holdich, who knows them from the Pamirs to Makran, though he hardly refers to his own achievements as a geographer, but treats the matter mainly from the historic standpoint, beginning with the Medes and Persians, and ending with Pottinger and Burnes and their contemporaries.

For the purposes of review we may divide the book into three parts. The first part—a quarter of the whole—deals mainly with what may be called the conjectural period of Assyrian and Persian and Greek. The second part—another quarter—is taken up by the Arabs; here the observer, describing country as wonderful as it is inaccessible to ordinary people, keeps conjecture subordinate to facts of observation. The third part, occupying nearly half the book, reviews the explorations and adventures of the modern European period; here facts predominate, and the romance of the story is of an individual kind.

We propose to give precedence to the second or Arab period, as this part of the book is the most original and certainly the most novel.

Everyone, of course, knows in a general way that Arab merchants and slave-dealers went everywhere—their footprints have been left all over Africa; Algerian slave-hunters even raided the coasts of Iceland once upon a time—but amid the alarums and excursions of historians and archæologists intent on Macedonian and Mogul invaders and Buddhist monuments, most people nowadays need to be told that "the whole of the Indian north-west frontier was much traversed by and thoroughly well known to the Arab trader."

Sir Thomas Holdich has much to say about these

old Arab caravan-routes and trade-centres, and much that is surprising to tell of the oblivion that has overwhelmed them. In Sind he has stood upon the site of an Arab city of which nothing whatever is left but traces of its cemetery. In the Helmund valley he has seen broken pottery "literally in tons"—the only remaining evidence of a vanished polity. In Central Afghanistan one may follow in the footsteps of the old Arab traders, with the story of their travels in hand, and may recognise the physical features of the road, but of the flourishing market towns that they mention there may be nowhere discernible "the faintest outward indication"—everything is now by Time's fell hand defaced. Only in southern Baluchistan did the author find, besides pottery and graves, undoubted ruins of cities and huge masonry dams that once held water-supplies.

The mediæval Arab traders used two main systems of communication, one through Herat and Afghanistan to Kabul and Afghan Turkestan, the other through southern Baluchistan (Makran) to the lower Indus valley. The routes of both systems are followed out by the author, and are illustrated by most excellent maps. In the account of the northern routes there are some short but interesting descriptions of those parts of the country that are least generally known. Something is said of Seistan, "the great central basin of Afghanistan, where the Helmund and other Afghan rivers run to a finish in vast swamps, or lagoons." The author speaks of it as a flat, unwholesome country, with remains of a really fine system of irrigation, and thinks that it does not justify its olden reputation as the granary of Asia. It must be remembered, however, that the Babylonian country, which in the time of Herodotus was by far the most fruitful known, and where the millet grew to such a height that Herodotus, though he well knew it, would not mention it lest it should appear incredible, does not at the present time justify its ancient reputation. Incidentally we also learn that Zamindawar, to the north-east of Seistan, and also watered by the Helmund, is a prolific region; that in northern Afghanistan the economic value of the Murghab river is still great; and that much of Afghan Turkestan is rich in agricultural possibilities. The author thinks that some of these "roads of the old khafila travellers may again be the roads of modern progress"; and he extols the route from Kabul and Ghazni to the Helmund as one of the "grandest high-roads in Asia, from the days of Alexander to those of Roberts."

The chapter on the "strange land of Makran"—the land of Gedrosia, where Alexander discovered that a trackless and waterless desert under a burning sun was an enemy against which even his unconquerable energy was impotent—is perhaps the most interesting and novel of the whole interesting story.

In days contemporaneous with the Heptarchy, the Arabs ruled Makran, and it was through Makran that they invaded India and conquered Sind.

"For three centuries there existed through Makran one of the great highways of the world, a link west and east such as has never existed elsewhere on the Indian border, save, perhaps, through the valley of the Kabul river and it affluents."

This highway ran about fifty miles north of the Makran coast that proved so disastrous to the Macedonian army, and behind the successive ranges of hills that face that coast. The author thinks that it may yet develop into a line of railway between India and Europe, particularly as it would enjoy the unique advantage, from a British point of view, of command and protection from the sea.

We get glimpses of some of the natural wonders of the Makran coast that almost remind us of pages of Hakluyt; submarine mud volcanoes, weird and fantastic strata, piles of sea-shells on upraised mud-flats, desiccated forests with the trees waiting to be fossilised as they stand; stiff, straight, spurless ranges of hills lying east and west like parallel lines of ramparts, with long, narrow, flat-bottomed valleys between them; and the curiosity of the archæologist will be whetted by allusions to ruined cities and tombs and gigantic irrigation works.

The interest of the latter half of the book is of quite a different kind. We now shake off the fascination of a dim storied past, and come face to face with the facts and political intrigues of the nineteenth century. Here we find an abstract and brief chronicle of the adventures of Christie and Pottinger, of the extraordinary Masson, of Lord and Wood, of the ill-fated Moorcroft, of Burnes, of Vigne, of Broadfoot and of Ferrier.

The author remarks, as a strange fact, that we are indirectly indebted to Napoleon Buonaparte and his nefarious designs on India for these early explorations of Afghanistan. On the same chain of causes, we may note in passing, hang the discovery of the Rosetta stone and the key to the arcana of ancient Egypt. Thus do we by indirections find directions out, and thus he that increaseth sorrow sometimes increaseth knowledge.

The author thinks nobly of his predecessors in the exploration of the gates of India. As explorers he calls them "magnificent." He in no way approves the opinion that their work is superseded, and he is inclined to doubt whether the superior mechanical equipment of the modern explorer altogether balances the superior methods of the pioneers who lived among the people, adopted their dress, ate their salt, and talked their "shop."

A few words may be said about the first part of the book, which contains, *inter alia*, an introduction and an account of Alexander's invasion of India. Here we think that the author hardly does himself justice; there is too much conjecture, not always relevant, and there are some statements and rather airy assertions that are hard to accept. For instance, the delightful history of Herodotus, which was written to the pious intent that the great and wondrous deeds of men might not be effaced by time, is referred to, almost barbarously, as a "geographical treatise," and, worse still, as a "gazetteer." Again, on p. 13, there is an extraordinary assertion about sailors and geography. If we have not misinterpreted it, it implies, if it does not actually assert, that sailors are not of much account as geographers. Now, among the things that we have kept from our youth up—and we fancy we are not singular in this respect—is a firm bel

that the greatest of all geographers were sailors, and we venture to adduce the names of Magellan, Columbus, Drake, Baffin, Davis, Hudson, Cook, Franklin, Ross, and McClintock in support of it, not to mention any names of those now living. Once more we demur to the use, in any literal sense, of such metaphorical expressions as "early Persian Department for geographical intelligence." The early Persian expeditions that we know anything about—namely, those against Greece—relied on spies and on guides picked up at the moment. Finally, where so much is said about Greeks and Alexander one is disappointed to find the famous Macedonian pike (sarissa) disguised as "sarina"; and ballistæ and catapeltæ (did Macedonians use the Roman ballista?) translated as "mounted infantry and artillery"; and Nearchus appearing now (correctly enough for those who like that fashion) as Nearkhos, and now (to suit no fashion) as Nearkos. In the case of a name like Nearchus, the free and easy fashion approved by Mr. Tony Weller is hardly to be commended. These things are blemishes which we should not care to remark if the book were not so good and so fresh in its essentials.

GENERAL BIOLOGY.

Allgemeine Biologie. By Oscar Hertwig. Dritte Auflage. Pp. xviii+728. (Jena: Gustav Fischer, 1909.) Price 16 marks.

IN the review of the second edition of this work, which appeared in this journal in 1906, it was pointed out that for any single man to undertake to give a circumstantial and critical account of the numerous problems of modern biology, and to support the conclusions arrived at by a sufficient record of the facts on which they are founded, is too stupendous a task, and one which certainly cannot be adequately carried out in a single volume. The third edition of Dr. Oscar Hertwig's book follows soon after the second, and it is to be inferred that it has been useful to a large circle of readers in Germany and elsewhere, though it has not attracted so much attention in England. It is doubtful whether the third edition will be more successful in this country than its predecessor. It is enlarged by the addition of eighty pages, and the illustrations in the text, which are well chosen and for the most part admirably executed, have been increased in number from 371 to 435.

Dr. Hertwig is a lucid writer, and has a style which attracts the reader and carries him easily through many difficult places, but in almost every chapter he leaves a certain sense of disappointment. There is a vast amount of information, and the argument is clear, and in many places convincing, but the detail is insufficiently worked out. This, perhaps, is no great fault in a text-book, if such information as is given is founded on the best and most recent authorities, and the references to literature are sufficiently full and up-to-date. But it cannot be said that this is always the case. To take some examples, the author informs us in the preface that the sections on the maturation divisions of the germ-cells, on natural and artificial parthenogenesis, on hybridism and the biogenetic law, have been largely re-written and revised in this edition.

In the section on the maturation divisions we are disappointed in finding that the discussion turns mainly on the phenomena observed in Ascaris. The work of vom Rath, Rückert, and Korschelt is also dealt with, but there is no mention of Farmer and Moore's important papers on the Maiotic phase in animals and plants, and their papers, which surely are old enough to be incorporated in a text-book published in 1909, are not even quoted in the list of literature. The section on natural and artificial parthenogenesis is more satisfactory, as a fair summary is given of the more important experimental researches on this subject up to the year 1908. The discussion of the results is, however, somewhat unconvincing.

Mendel's law, which was ignored in the second edition, is concisely dealt with in the latter half of chapter xiii. Here only a few simple cases are quoted to illustrate Mendelian principles, and no discussion of more complicated and unconformable cases is attempted. As in many other parts of the book, the experiments of Continental authors are quoted, but the large amount of English work on the subject is not taken into account.

Dr. Hertwig is quick to take advantage of the results of Mendelian work in support of his own theories of inheritance, but it is not always easy to understand in this connection, as in many others, what his real opinion is. It might be described, in Mendelian terms, as a polyhybrid of several theories promulgated by different authors; and sometimes one is inclined to think that, under stress of argument, his system resolves itself, by a process of segregation, into its original elements. He maintains, as he was one of the first to assert, that the chromosomes are the bearers of the heritable qualities of the organism, and it may be said in this connection that he disposes too easily of the evidence furnished by Crampton, E. B. Wilson, and others, that specific organ-forming materials are located in the cytoplasm of the egg. But while admitting the existence of a nuclear idioplasm, he will have nothing to do with Weismann's theory of biophors and determinants, but holds with Nägeli that the idioplasm has a micellar structure, and that it is distributed equally to every product of cell-division. None the less, he speaks of particles (Teilchen) which are bearers of inheritable qualities, and comments on the fact that Mendelian experiments show that these particles must be mobile and capable of forming new combinations. Hence, he says, it is clear that the chromosomes cannot retain their individuality, but must be regarded as tactical combinations of smaller units. Few will be disposed to quarrel with this conclusion, but it is not obvious wherein these "smaller units," capable of entering into tactical combinations, and representative of the specific or racial characters (Merkmale) of the adults, differ from Weismann's determinants.

Here, as in several other places, Dr. O. Hertwig appears to be inconsistent, but it would be an injustice to press this charge of inconsistency too closely. He is a champion of an epigenetic theory of development, and argues with admirable clearness in favour of the view promulgated at the same time by Driesch and himself, that the destiny of any given cell in a developing organism is a function of its position. At the same time, he brings into account the indisputable fact that the characters of the organism, and therefore of the cells composing it, are determined beforehand by the constitution of the fertilised ovum from which it is derived. In other words, he admits preformation, but preformation tempered by the mutual interaction of parts and the influence of external conditions.

There are many indications that the impartial position adopted by Dr. O. Hertwig is the right one, and, after all, it is the position taken up by Darwin, who wrote that "there are two factors, the nature of the organism, which is much the more important of the two, and the nature of the conditions." But latterly opinion has been sharply divided on these questions, and to partisans of the preformationary or epigenetic schools any attempt to reconcile such apparently irreconcilable theories exposes the author to the charge of inconsistency. In truth, it is very difficult to draw certain conclusions from the available evidence, much of which appears to be contradictory. It is the chief merit of Dr. Hertwig's work that he refuses to take extreme views, and no better exposition of the middle position can be found than is contained in this volume.

COMMERCIAL ORGANIC ANALYSIS.

Allen's Commercial Organic Analysis. A Treatise on the Properties, Modes of Assaying, and Proximate Analytical Examination of the Various Organic Chemicals and Products employed in the Arts, Manufactures, Medicine, &c. Fourth edition, vol. i. Edited by Dr. H. Leffmann and W. A. Davis. Pp. x+576. (London: J. and A. Churchill, 1909.) Price 21*s.* net.

THE first volume of the last edition of this well-known treatise was issued in 1898, and was remarkable for the introduction of two features, which have become the most striking characteristics of this first volume of the new edition. These are the recognition of the fact that the subjects to be dealt with are so numerous and important that a single compiler can no longer cope with them, and that in publishing a large and important work of this kind in English it is desirable to endeavour to meet the needs both of readers in this country and in the United States. This latter consideration is a very important one, and it is to be hoped that its recognition will facilitate the re-publication of other large works of reference in English.

This volume is divided into ten sections, and each of these is written by an expert in that branch. It will be a matter of satisfaction to those familiar with "Allen" to find that in bringing the subject-matter up to date it has been possible to retain the old arrangement. The introduction is written by the English editor, Mr. Davis, and shows perhaps less change than most of the other sections, the most important additions being useful chapters on (1) refractometers, (2) spectrometers and spectrographs, and (3) the determination of moisture, "crude fibre," and ash, all these being of sufficient general importance to warrant their discussion in the introduction. This section is, on the whole, a very satisfactory piece of work, though it is rather doubtful whether it was worth while to devote about three pages (53–6) to an illustrated description of an arrangement for maintaining a temperature constant to within a few thousandths of a degree, since the commercial analyst is not likely to want refinements of this description in practice. Further, the space devoted to the "Employment of Immiscible Solvents" (pp. 79–82) might have been much curtailed, as the present-day analyst is probably perfectly familiar with the separating funnel and its use. The table at the end of this section is reprinted from the third edition, and should have been omitted, as it is too general to be of any value, and moreover, contains the inaccurate statement that cantharidin, picrotoxin, and santonin are glucosides. It is also a mistake to refer to "saponin" as if this were a single definite substance.

Dr. Leffmann, the American editor, contributes two sections, the one entitled "Neutral Alcoholic Derivatives," and the other, not very happily named, "Aci Derivatives of the Alcohols."

Notable additions are the very useful article on "Yeast" by Mr. Emil Schlichting, and the excellen section on "Papers and Paper-making Material by Mr. Sindall. Mr. G. C. Jones contributes th sections on "Alcohols" and "Wines and Potabl Spirits." Both these seem to contain all the data a analyst is likely to need, but in the second sectio something might have been said regarding the analytical work on rum carried out in recent years i Jamaica and British Guiana.

The remaining sections are those on "Sugars" ar "Starch and its Isomerides," both written by D E. F. Armstrong. In the main, these are excelle *résumés* of the present position of the chemistry these subjects, and the omissions are of a triflir character. In the first some reference should ha been made to the detection and estimation of su glucosides as salicin and strophanthin, used in me cine, but possibly it is intended to deal with these und "Drugs" in a later volume. Under "Starch" no me tion is made of the analytical characters of the "sa substitutes" that are now prevalent in commer The article on gums in this section is little more th a replica of that in the third edition, and it is unf tunate that the author did not take the opportun of correcting the errors in it.

The book as a whole is very well edited, but th are a few curious mistakes; thus in three places t name of one of the authors is written "Schlichting" and in the fourth and most important place, at the head of his contribution, it is given "Schlighting." The heading of one section is prin

as "Starch and Isomers" in the list of contents, and as "Starch and its Isomerides" above the text of the section itself. Finally, the book is described as "printed in America." Printers in the United States do not apparently believe that "the whole is greater than its part." T. A. H.

TROPICAL CLIMATOLOGY.

Handbuch der Klimatologie. By Prof. Julius Hann. Band ii., Klimatographie. 1 Teil, Klima der Tropenzone. Dritte, wesentlich umgearbeitete und vermehrte Auflage. Pp. xii+426. (Stuttgart: J. Engelhorn, 1910.) Price 14 marks.

THIS is the first part of vol. ii. of the third edition of Prof. Hann's "Handbuch der Klimatologie." Vol. i. dealt with general principles, and we now come to the detailed consideration of the climates of different parts of the world. The volume before us concerns itself with the tropics, the consideration of temperate and polar regions being reserved for subsequent volumes. The author has not confined himself strictly to the area lying between $23\frac{1}{2}°$ north and south of the Equator. When desirable he has gone outside this region. Roughly speaking, he discusses that portion of the earth's surface which has an annual mean temperature of 20° C. or above. The isotherm of this value may be taken as marking the polar limits of the trade winds, when definable, and of the palm tree.

A great part of the book is taken up with tables, interspersed with descriptive paragraphs taken from the writings of travellers or residents in the regions under review. The tables refer for the most part to the elements, temperature, and rainfall, but where the data are available, tables of wind direction frequency, humidity, cloud amount, and pressure are added. The additional matter incorporated since the second edition appeared in 1897 is considerable. For some areas the author has had the advantage of consulting works such as Captain Lyons's "Physiography of the Nile Basin," but for others he has had to go into the byways of meteorological literature. The labour involved in collecting and working up the scattered fragments must have been prodigious even for so indefatigable a worker as Prof. Hann, and we can but admire and marvel at the thoroughness with which the task has been completed. Much time has been expended over the calculation of true means of temperature from daily extremes or from readings at fixed hours. Even so, Prof. Hann regards many of the values as still uncertain, but in the absence of adequate knowledge of the course of the diurnal variation, no more can be done at present.

The introductory chapter discusses the general characteristics of tropical climate. A special section is devoted to its physiological action on the human organism, particularly that of the white man, and affords an opportunity of referring to the recent advances in the domain of tropical medicine. After that we are introduced successively to West Africa and the Congo, East Africa with the Sudan, the monsoonal area of Asia and northern Australia, the Pacific islands, and finally to tropical America.

OUR BOOK SHELF.

The Fourth Dimension Simply Explained. Edited by Prof. H. P. Manning. Pp. 251. (New York: Munn and Co., Ltd., 1910.) Price 1.50 dollars net.

THERE are few fallacies which have done more to mislead the unscientific public than the misconception known as *the fourth* dimension. The use of this term is calculated to convey the false impressions, first, that hypergeometry is limited to space of four dimensions instead of being extended to space of n dimensions where n is any positive integer; second, that even not going beyond four dimensions, there is one particular coordinate called the fourth dimension which stands out from the rest, and alone is worth considering.

Now so long as we regard four-dimensional space as a geometrical conception, there is no difference between its fourth dimension and its first, second, and third dimensions, just as in ordinary solid geometry there is no third dimension distinguishable in any respect from a first and second dimension. On the other hand, as soon as we introduce the concept of a fourth coordinate differing essentially from the other three, this coordinate ceases to be a geometrical conception, and may be taken to represent time, density, or anything else we like.

Some American who had some money to get rid of and had no better use for it offered, in the *Scientific American*, a prize of 25*l.* for the best popular explanation of *the fourth* dimension, and the present volume is a collection of selected essays that were submitted in the competition, with an introduction by Dr. Henry P. Manning. It must be admitted that what the authors have written is mostly sensible and reasonable enough, and in no way contradicts the remarks that have been made above. If the book had been brought out under the title "Hyperspace Simply Explained," and the titles of those essays where the words occur had been altered by the substitution of "four" for "the fourth," the utility of the book would have been considerably increased. It contains very little that can be described as *unscientific*.

Diagram showing the Classification of the Elements: Periodic Arrangement. Size 44×68 inches. (London: Baird and Tatlock, Ltd.) Price, mounted on cloth, rollers, and varnished, 25*s*.

THE "periodic" classification of the elements plays such an important part in courses of inorganic chemistry for students that a large wall diagram illustrating this classification has now become a prominent feature in the equipment of the chemical lecture theatres of colleges and technical institutions. Such diagrams have usually had to be prepared by the staff of the department concerned. Many teachers of chemistry will therefore welcome the issue of a large printed chart, suitably mounted on stout linen, giving the usual periodic classification of the elements with their names and atomic weights. The lettering is bold and clear, although, perhaps, a little wider spacing might have been allowed with advantage.

The chart fails to show, however, the differentiation of each vertical group into "odd" and "even" series. From a teaching point of view there is much to be said for placing the helium and argon group of elements before the alkali group and not after the halogens. The method of classification used for the iron-platinum group is perhaps not quite the most satisfactory one, though this is, of course, at present largely a matter of individual opinion. The chart as a whole would probably gain in clearness by replacing in future issues the names of the elements by their customary symbols.

Apart from the relatively minor points just mentioned, the chart will probably prove of considerable service to lecturers of chemistry by relieving them of the necessity of preparing the large diagram illustrating the periodic classification which is now essential for class teaching of chemistry.

Leitfaden der Biologie für die Oberklassen höherer Lehranstalten. By Dr. O. Rabes and Prof. E. Löwenhardt. Pp. x+248. (Leipzig: Quelle and Meyer, 1910.) Price 3 marks.

This book is intended for the use of pupils who have already had a certain amount of biological training in school. It covers a very great deal of ground in a very superficial manner, but in the hands of a capable teacher it should serve as a good foundation for an extremely interesting course of general biology. It commences, in what we conceive to be a very logical manner, with a general account of the cell, but the fact that this occupies less than one page is typical of the superficial method of treatment. A few unicellular organisms are then dealt with, chiefly from the physiological point of view.

The general physiology of multicellular organisms comes next, and the first part concludes with a description of seventeen types of plants and animals, ranging from bacteria to the bean in the vegetable series, and from Paramœcium to the rabbit amongst animals. The descriptions and illustrations of these seventeen types occupy twenty-six pages! The type system has become almost vestigial.

The second part of the book is devoted to the dependence of organisms upon their environment (œcology), including geographical distribution and an appendix on the geological history of plants and animals and the theory of descent. The third part deals with man, mainly from the physiological, ethnological, and palæontological points of view.

The book is very copiously and admirably illustrated, but four or five volumes of its size would be required to do justice to the subject-matter.

Tarr and McMurry's Geographies. The Five Book Series. First part, Home Geography. Pp. xi+112. Price 2*s.* 6*d.* Second part, The Earth as a Whole. Pp. ix+168. Price 2*s.* 6*d.* Third part, North America. Pp. xix+469. Price 4*s.* 6*d.* Fourth part, General Geography, South America and Europe. Pp. xvii+378. Price 3*s.* Fifth part, Asia and Africa. Pp. ix+214. Price 2*s.* 6*d.* By Prof. Ralph S. Tarr and Prof. Frank M. McMurry. (New York: The Macmillan Co., 1908, 1909, 1910.)

The authors, who are well-known writers on geographical subjects from the point of view of the school, have evidently taken great pains to adapt themselves to the needs and capabilities of young pupils. On the whole, they have been successful in producing a good, workable course of school geography. Written primarily for American boys and girls, great prominence is given to the geography of the United States and less importance to that of the British Isles. When it is pointed out, however, that while 230 pages are devoted to the United States, the British Isles are disposed of in 35 pages, it will be seen that the volumes are hardly suitable for adoption as class-books in our schools. But they should prove of great assistance to our teachers in showing how geography may be taught in a way to arouse interest and develop thought. Every part is well and profusely illustrated with views, diagrams, and photo-relief maps. In addition there are numerous coloured political maps, but no use appears to be made of coloured orographical maps.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

Koch's Discovery of the Method of Plate-culture of Micro-organisms.

Reading the interesting notice of Robert Koch which appeared in Nature of June 2, I was reminded of an incident mentioned concerning his early scientific career in the preface to Cohnheim's "Gesammelte Abhandlungen." Cohnheim, the pioneer of what has been sometimes termed physiological pathology, died in 1884 at the early age of forty-five. The preface to his collected works, published in the following year, contains a charmingly written memoir of him from the pen of his friend W. Kühne, the accomplished Heidelberg physiologist. The obituary notice of Koch in Nature rightly stressed the immense value to bacteriology of his invention of the plate-method for obtaining pure cultures of micro-organisms. The incident reported by Kühne in his memoir of Cohnheim has reference to that, and to Cohnheim's contact with Koch in consequence of it in the year 1875. At that time Cohnheim was already full professor of pathology in the University of Breslau, and his brilliance as an investigator was already attracting to his laboratory men of promise from all parts. Koch, on the other hand, was in country practice in Silesia, and quite unknown to the scientific world. Koch's discovery of the plate-method led to Cohnheim's discovery of Koch, and the enthusiasm and remarkable prevision at once shown by the young professor of pathology regarding his unknown compeer, only two years younger than himself, are strikingly told by Kühne. His words run:—

"In November, 1875, Robert Koch wrote begging Cohn, the celebrated botanist, Professor of Botany in the University, to look at cultures of anthrax bacilli which he (Koch) had prepared pure; and for that purpose Koch went to Breslau to see him. Cohn had had many tiresome and disappointing experiences of cultures of pathogenic organisms brought to him with the assertion that they were of pure and isolated species; in the present instance he naturally felt at first little confidence, but after interviewing Koch he sent a messenger to the Pathological Institute asking someone to come over because a visitor, Dr. Koch, had something to show which was 'quite right and very interesting.' In the Pathological Institute Weigert, Cohnheim's assistant, was about to perform an autopsy; Cohnheim himself therefore went across to the Botanical Laboratory, and when he returned he said, 'Now leave off everything here and go over to Koch. The man has made a tremendous discovery, which for its simplicity and its accuracy of method deserves admiration all the more because Koch himself is living entirely remote from scientific intercourse, and has done it all by himself and finished it right out. There is nothing whatever to add to it. I regard it as the greatest discovery in the whole field of bacteriology, and I believe Koch will surprise us all in times to come with further discoveries and put us all to the blush for our laurels.'"

Perhaps this picturesque reference to a turning point in Koch's earlier career, being contained in a volume little likely to be sought for information about him, might escape the notice of some whom it would interest, especially at the present time. C. S. Sherrington.

The University, Liverpool.

Crocodiles and Sleeping Sickness.

In the obituary notice of Prof. Robert Koch in Natur of June 2 (p. 404), it is stated that "Koch suggested tha the crocodile might be the reservoir host of the trypano some that gives rise . . . to sleeping sickness." This a statement that has been made very often, especially i the daily Press, but which I, for my part, have never bee able to verify, although I have some acquaintance wit Koch's writings on the subject of sleeping sickness. Sin this idea has been attributed so often to Koch, it is doub

less safe to assume that there is some foundation for doing so, and I should be very glad to learn when and where Koch made the suggestion that the crocodile is a reservoir host for sleeping sickness. The point is merely one of historical and bibliographical interest, since in his latest writings Koch expressly repudiated the idea of any such connection between crocodiles and sleeping sickness (see NATURE, February 18, 1909, p. 458, and May 5, 1910, p. 279; also the Bulletin of the Sleeping Sickness Bureau, No. 11, November 5, 1909, p. 421, footnote).

E. A. MINCHIN.

Lister Institute of Preventive Medicine, Chelsea Gardens, S.W., June 8.

PROF. MINCHIN's letter comes as a reminder, so often repeated, and apparently not too often, that one should verify one's references. I had read a leading article in the *Lancet* of October 30, 1909, on the work of the German Commission, but I had not referred to the original report, and I am afraid that the statement that the *Glossina palpalis*, on occasion, takes its nutriment from the unprotected parts of the crocodile led me somewhat astray as to the exact significance of Koch's observations and recommendations. I am glad that Prof. Minchin has directed attention to the matter. *My* excuse must be that the article had to be in the hands of the editor within a few hours of my receipt of a re-directed telegram, and that I had to depend upon my memory for almost everything but a few dates and data which appear in "Wer ist's."

THE WRITER OF THE ARTICLE.

The Earth and Comets' Tails.

IN spite of the unreserved predictions of astronomers, the earth did not pass through the tail of Halley's comet on May 18–19, nor subsequently. The tail as seen in the morning sky, previous to the transit of the comet across the sun's disc, appeared like a long and straight beam of light stretching from the horizon to Aquila. It was noticed from day to day that the tail was practically fixed in position in the sky. We rather expected the tail to get nearer to Venus and Saturn as the comet approached the ecliptic, but it remained stationary. On the morning of transit, May 18–19, the tail was unchanged, but a second branch to the south was now noticed. It joined the northern branch to the east of the Square of Pegasus. Unfortunately, this southern branch was near the zodiacal light, and only distinguished from it with difficulty.

Both these tails were seen morning by morning, including this morning (May 22, Civil day), but they have diminished in brightness, and were difficult to see. Further observation of these will be impossible, because of the moon remaining above the horizon until after dawn during the next ten days. The whole eastern horizon where the tails meet and where the zodiacal light is was suffused with a dim and indefinite glow, which was particularly noticeable on May 18–19 and 20–21. This glow was not so definite in boundary as the zodiacal light. When the comet was seen on the evening of May 20 we were surprised to see it had the ordinary tail pointing away from the sun as usual. It had been noticed for several days that in the neighbourhood of the sun the sky was not so blue as usual, but this was the case even a week before the transit, and is probably merely a meteorological phenomenon. This brief summary of the facts will suffice here; the observations in detail will be published elsewhere.

We have now to explain the reason why the earth did not pass through the tail of the comet, and why the tail broke up so that some of it was left in the morning sky, where it remains, and is slowly losing its luminosity, and some (or another tail) appeared in the evening sky. It is well known that a comet under the sun's radiant action (I do not attempt to define it more closely) expels corpuscles towards the sun which the sun repels, and these luminous corpuscles form the tail. This process goes on even when (as in the case of Halley's comet) the distance between the comet and the sun exceeds the distance of the earth from the sun. If the nearer planets do not show tails it is because these corpuscles have been shed by the planets ages ago. In short, a comet and a planet under the radiant action of the sun, and the sun itself, all repel these corpuscles. This being so, it is impossible for the earth to go through the tail of a comet—it simply repels the tail, and, as a consequence, instead of a passage through it, a disruption near the time of passage must occur, one part being left in the (in this case) morning sky, whilst a new one is developed in the evening sky. Here I may remark that on the evening of May 20 the measured length of the new tail was 19°, on May 21 32°, and on May 22 it was 40°.

Again, the earth is bombarded with meteorites, which are also throwing off corpuscles. These will be repelled by both earth and sun, so that if we look at the part of the sky opposite to the sun we should, and do, see the faint tail thus formed which is known as the Gegenschein. This simple theory explains all the facts of observation, and, if it is correct, will save nervous individuals some worry when the next near approach of a comet's tail is imminent.

R. T. A. INNES.

Transvaal Observatory, May 22.

P.S.—Mr. H. C. Reeve, of Lorentzville, under date May 22, has sent me a letter conveying the same idea. He says:—"Whatsoever nature the stress between the sun and the comet may be which causes the repulsion of the tail . . . the same stress must also exist between the earth and the comet . . . under these circumstances the earth could not possibly pass through the comet's tail."

ON the morning of May 19, at between 4 and 4.30 a.m. standard Indian time ($5\frac{1}{2}$ hours from Greenwich), the tail of Halley's comet could be seen stretching as far as the Milky Way near Sagittarius, if not beyond. The tail was much fainter than it had been two or three days previously, but was still quite distinct.

In the constellation Sagittarius, however, a dark band, like a shadow, stretched diagonally right across the tail upwards from east to south at an acute angle of about 20° to 30° with the direction of the tail. The edges of the band were approximately straight and parallel, and the width of the band was perhaps two or three degrees.

No luminosity could be noticed within the band.

If, as seems probable, the tail was then entering into the shadow of the earth, it would appear that at any rate the major portion of the light of the tail was light reflected from the sun.

A. S. HEMMY.

Government College, Lahore, Punjab, May 26.

The Term "Radian" in Trigonometry.

NATURE of April 21, containing Mr. Thomson's letter, has just reached me, and I hasten to say that, had I known that his father had ever claimed to have originated the word "radian" I should, of course, have mentioned the claim in my communication to NATURE of April 7. As a matter of fact, Prof. Thomson never did so in my presence, and he certainly knew shortly after he came to Glasgow that I had on my own initiative proposed the word, and had made use of it for some years. One day when I met him accidentally he told me that he had found a college student who had been a pupil of mine using the word "radial" for a unit-angle, and that, while agreeing with me as to the need of such a word, he had doubts as to the suitability of the terminal syllable. My reply, as may be guessed from my recent communication, was that "radial," "radian," "rad," had all something to be said for them, and I referred him to my letter to NATURE dated April 4, 1870. On at least two subsequent occasions we spoke of such things, and he supported the termination *-an* in this particular case, because of a supposed analogy with the geometrical term "median." All this, you will see, does not preclude the possibility of an independent origination of the term by him in July, 1871, as stated by Mr. Thomson, and I therefore regret that here there is no chance of me having the satisfaction of seeing the printed word in the Calendar of Queen's College, Belfast, for 1873–4.

May I direct attention to the fact that in justification of his letter Mr. Thomson unfortunately represents me as saying that it was in 1874 that "the word was finally adopted"? This is quite incorrect. If he will kindly

glance at my letter again, he will see that, speaking of the various forms which I had used or had under consideration during the preceding five years, I said that in that year (1874) "the form *radian* was definitely adopted by me." It is the words *form* and *by me* that here make all the difference.

The same mail steamer which brought Mr. Thomson's letter brought for delivery a few hours later a tattered copy of the third edition of Todhunter's "Plane Trigonometry," sent to me as evidence of a still earlier use of the word "radial" to denote the unit-angle in question. This text-book was the property of a pupil of mine in 1867, and it contains in my handwriting of that date the words "1 radial $=180°/\pi$, 1 degree $=\pi/180$ rad." When next in England I shall offer it for your own and Mr. Thomson's inspection. THOS. MUIR.

Cape Town, South Africa, May 11.

I SHALL be very pleased to send Dr. Muir a copy of my father's examination questions of June, 1873, containing the word *radian*; and when Dr. Muir returns to England I should like to show him my father's copy of the "Imperial Dictionary" containing a note in his own hand saying that he had proposed the word in July, 1871. So far as I know, he did not meet Dr. Muir until he came to Glasgow in October, 1873.

It thus appears that *radian* was thought of independently by Dr. Muir and my father, and, what is really more important than the exact form of the name, they both independently thought of the necessity of giving a name to the unit-angle. JAMES THOMSON.

22 Wentworth Place, Newcastle-on-Tyne, June 1.

The Nutritive Value of Black Bread.

IN the issue of NATURE for June 2 (p. 398) there is a letter from a correspondent in reply to the article on "The Nutritive Value of Black Bread." The correspondent points out that the writer of the article overlooked one all-important question, viz. how much of the nitrogen present in each form of bread is actually digested? In the original article the writer complained that misleading statements were made by some politicians during the last Parliamentary General Election with regard to German black bread. No doubt some of your readers expected to see a letter or two in reply to this complaint. There has not been one.

Now what are the facts with regard to German black bread? What the people of the United Kingdom care about is what their bread will cost. They do not care whether that bread, which the Germans themselves call "black bread," is black, or brown, or grey. The following are the prices obtained from a large bakery in the town of Elberfeld last December:—

Flour.

Description	Price per 14 lbs. s.	d.
Finest wheat flour ...	2	8
Wheat flour ...	2	5¼
Best rye flour ...	2	1¾
Ammunition flour ...	1	10
Coarse rye flour ...	1	9¼

Bread.

Description	Price per 4 lb. loaf d.
White bread, made with milk and wheat flour	9½
Fine bread, made of wheat and water ...	8¾
Rye bread, pure ...	6
Rye + wheat (¼ wheat + ¾ rye) ...	6
Rye + wheat (⅓ wheat + ⅔ rye) ...	6
Ammunition bread...	5¾
Black bread ...	5

From the above figures, which have never been challenged, your readers can draw their own conclusions.

Protectionists are most anxious to prove that rye bread is good, and they suggest that it is preferred to wheat bread. Free Traders never denied that rye bread was good. They stated that it was an inferior bread to wheat, and that the chief reason for its use in Germany was its lower price in comparison with wheat bread. Rye costs less than wheat in Germany, and this is a proof that it is an inferior grain. The bread which is reckoned the finest bread is wheat bread, all the world over, and in the best hotels in Germany it is regularly served with all meals. On account of the duty the price of wheat bread is too high in Germany for working-class people, and they buy breads made from mixtures of cheaper grains, according to price. The "black bread" in Elberfeld is made from a very coarsely ground rye flour, and it is sold and spoken of as "black bread," although it is a very dark brown in colour. FRED SMITH.

92 Halsbury Road, Fairfield, Liverpool, June 4.

IT is assumed in the letter that the whole difference in price is due to the duty on wheat. But an examination of the figures given shows that the cost of the various breads is not closely proportionate to the price of the flours, and it would seem that the bakers take a much larger profit on the wheaten bread. Indeed, this must certainly be so unless the yield in bread from a given weight of rye flour is much larger than from a similar weight of wheaten flour, a point upon which no information is to hand.

THE WRITER OF THE ARTICLE.

The Recoil of Radium B from Radium A.

WHEN radium A is transformed into radium B, the process is accompanied by the expulsion of an α particle. It has been shown that in these circumstances the atom of radium B recoils from the α particle with considerable velocity, as is to be expected from a consideration of the momentum of the system.

Some experiments have recently been made to determine whether radium B is charged when it recoils, and, if so, to ascertain the sign of the charge carried by it. Measurements to determine whether the radium B was deflected when passing through an electrostatic field revealed the fact that at least some of the atoms of this product, on formation from radium A, carried with them a positive charge when projected through a high vacuum. Experiments were therefore made to measure the magnitude of the deflection suffered by the atoms of radium B when projected through an electric field at right angles to the direction of motion of the particles.

Now, since the α particles from radium A travel with a velocity of 1.77×10^9 centimetres per second, the recoiling atoms of radium B should have a velocity of 3.3×10^7 centimetres per second, on the assumption that the atomic weight of radium B is 214 and that of the α particle 4. The deflection to be expected when subjecting the recoil particles to a field of known strength can easily be calculated if it be assumed that each particle carries one atomic charge, or half that carried by an α particle. The results of the experiments to deflect the radium B in an electrostatic field were consistent with this theory of the phenomena, but the experimental difficulties were such as to prevent us, so far, from making very accurate determinations.

Before attempting to make these measurements with greater accuracy, it was thought of interest to investigate the deflection of radium B in a magnetic field. This has been done by Mr. E. J. Evans and one of us, and the results obtained show that when radium B recoils through a magnetic field the deflection suffered by the particles is of the size to be expected from theory.

Taken together, the results of the electrostatic and magnetic deflections of the atoms of radium B after recoil leave little doubt that the atomic weight of radium B is in the neighbourhood of 200, that this product carries with it on recoil a single positive atomic charge, and that the velocity of the particles is of the order of magnitude to be expected from considerations of momentum. It is, however, hoped that subsequent experiments may lead to a determination of these important quantities with accuracy.

W. MAKOWER.
S. RUSS.

Physical Laboratory, The University, Manchester, June 10.

Curve Tracing and Curve Analysis.

THE review of a book on practical curve tracing in NATURE of June 9 is tantalising to one who is not in the least interested in drawing the graph of an equation, but who is frequently plotting curves from experiment, and who would like to find formulæ, not only to fit them, but to explain them. I look through most of the reviews of mathematical books in NATURE in the hope of discovering one that deals with the practical analysis of curves, and I am continually disappointed.

Can no mathematician be induced to recognise that for some of us an equation is the end, and not the beginning, of a piece of work? In innumerable cases experimental work ends with a curve, such, for example, as a hysteresis curve, and no attempt is made to find an equation to fit it.

Half a dozen rules exist, the uses of log. and semi-log. paper can easily be explained, but nobody has gathered them together with explanation of the difference between empirical formulæ and rational equations, of interpolation, smoothing, and of the legitimacy of extrapolation.

London, June 9. A. P. TROTTER.

A Brush for Collecting Mercury.

SINCE more or less mercury is always spilled around the laboratory, a simple and efficient mercury collector is of great use. I have found a very good one, and, since I have not seen it in use before, I will describe how it is made.

It is made like a paint-brush, with the difference that #40 copper wire is used instead of camel's hair in the brush part. The fine copper wire is then amalgamated with mercury. Use the brush as though painting with it. It will take up large globules and go into cracks and collect the smallest particles, so that none need be lost. Use a cup when collecting, and when the brush is full shake the mercury into the cup.

GEORGE WINCHESTER.

Washington and Jefferson College, Physical Laboratory, Washington, Pa., May 28.

LIGHT ALLOYS.

THE problem of producing an alloy which shall combine great strength with a low specific weight has been before metallurgists ever since the commercial manufacture of aluminium became an accomplished fact; more recently, however, the requirements, in the first place, of racing yachts, then of motor cars and of motor cycles, and, finally, the pressing problems of aërial navigation, have added a rapidly increasing importance to the whole question. At the present moment German manufacturers particularly are putting forth claims in regard to achievements in this direction which appear startling at first sight, and it is interesting to examine the whole state of the question.

The need for a light alloy lies in the fact that pure or nearly pure aluminium is, unfortunately, very weak mechanically. Its low specific gravity (2·71) is more than counterbalanced by the fact that its tensile strength, even in the form of rolled bars, does not exceed 7 tons per square inch. If these figures are compared with those of the best special alloy steels suitable for structural purposes, we find that some of these show tenacities up to 64 tons per square inch, with a density of approximately 7·9. Consequently, a bar of aluminium, to bear the same ultimate load as a bar of such steel having a cross-sectional area of one inch, must have a sectional area of approximately 9 square inches, and would therefore weigh about three times as much as the steel bar. A light alloy which is to compete successfully with such special steels, therefore, must either be much lighter than pure aluminium or it must combine with the density of aluminium a tensile strength of 21 tons per square inch.

So far as alloys consisting principally of aluminium are concerned, it does not appear that this tensile strength has ever been attained, except in the case of hard-drawn wires the ductility of which has been reduced to an excessively low value. It must, however, be borne in mind that the high-tension steels referred to above cannot be employed in excessively thin sections, so that in many special cases, where the scantling of structural parts cannot be reduced to minute dimensions, while the strength required is not very great, light alloys may be employed with advantage as compared with alloy steel. The same argument applies, however, to a comparison made on similar lines between light alloys and the stronger kinds of wood. These woods are all considerably weaker, per square inch of sectional area, than the light alloys now available, but when their much lower density is taken into account, as well as the advantage of larger scantlings, the result must in many cases be favourable to the employment of wood. It is for this reason that the frames of most aëroplanes are constructed of wood. When, however, an alloy of density less than 3, and possessing a tensile strength of more than 20 tons per square inch under conditions allowing of a ductility equivalent to an extension of not less than 15 per cent. on a 2-inch test-piece, becomes available, its employment will become advantageous as compared both with the best alloy steel and the best wood.

The light alloys available at the present time are somewhat numerous, and, as regards those of them which are patented or otherwise proprietary articles, it is difficult to obtain satisfactory data; it is certain, however, that extravagant claims are often advanced for such alloys, and these are not verified when samples are tried in a testing machine.

The claims of those advertising or selling such alloys must therefore be looked upon with much reserve.

Among the earlier alloys of aluminium which found a certain amount of practical application were those with iron and with nickel. One of the racing yachts engaged in one of the later races for the America Cup was built of plates rolled from one of these alloys, but the metal suffered from excessively rapid corrosion, and the presence of iron in aluminium alloys, although it undoubtedly confers considerable strength upon them, is rightly regarded as extremely undesirable. At the present time, the most completely studied of the light alloys are those in which copper is incorporated with the aluminium, either alone or with the addition of other elements, such as manganese. In the form of rolled bars and sheets, these alloys attain a tensile strength of slightly more than 17 tons per square inch, with an elongation of 15 per cent. on 2 inches; these figures apply almost equally to alloys containing about 4 per cent. of copper alone, or to those containing 3 per cent. of copper and 1 per cent. of manganese, or 2 per cent. of copper and 2 per cent. of manganese, the specific gravities of all these alloys lying close to 2·8. So far as trustworthy data are available, these figures probably represent the best available alloys of this character. Alloys of aluminium with from 15 to 20 per cent. of zinc may possibly yield somewhat higher figures, but, owing to the presence of a considerable proportion of zinc, their density is also much higher, so that they can hardly be classed among the light alloys.

The light alloys at present employed in practice are principally used in the form of more or less complicated castings, such as motor-car engine crank-cases, the corresponding parts of aërial motors, and similar purposes. When thus used the alloys cannot be compared with special alloy steels, and still less with wood, and they hold the field quite easily against cast-iron, brass or bronze of any kind. For these

purposes, hardness rather than ductility is desired, and alloys containing rather more than 4 per cent. of copper, or the corresponding amount of manganese, can be employed. The casting of these alloys presents some difficulty, but a considerable number of founders are able to produce castings of this kind with regularity; the secret of their success lies largely in casting the alloy at a suitable temperature, and in the preparation of a mould having a hard and very dry surface. All the alloys of this class undergo a comparatively enormous amount of shrinkage in passing from the totally liquid to the totally solid condition, and unless due allowance is made for this contraction, faulty castings always result.

In the case of the aluminium-zinc alloys, a difficulty of another kind arises; while these alloys are less viscous when molten, and flow into the moulds more freely than the aluminium-copper alloys, they are very weak and brittle while hot, and castings made of these alloys are very apt to crack while cooling if their contraction is opposed to any considerable extent; it is probably on this account that these alloys have acquired the reputation of being "treacherous." They have, on the other hand, been employed with some success for the production of so-called "die castings." These castings are produced by means of metallic moulds, and can be made so accurate that no machining is required even for such objects as screw-threads and certain parts of instruments. On the other hand, these alloys are said to be weak under vibration, but this statement as yet requires confirmation by systematic investigation.

The question of the power of light alloys to resist corrosive influences is one of considerable importance; it has been generally accepted by those accustomed to deal with aluminium and its alloys that the pure metal is much more resistant to corrosion than any of its alloys, and, as regards some of these, this view is undoubtedly correct. The numerous "solders" which have been advocated for jointing aluminium and its alloys all suffer very seriously from this point of view. It must, of course, be borne in mind that aluminium itself has a powerful affinity for oxygen, and only protects itself from rapid atmospheric oxidation by the formation of a very thin coating of oxide on all exposed surfaces; if this coating is ruptured, as, for instance, by friction, continuous oxidation results, and the presence of an alloyed element in the form of a distinct constituent may cause such interruption. Again, the contact of aluminium with another metal, in the case of all those metals usually met with in engineering construction, leads to the formation of galvanic couples, and the consequent rapid corrosion of the aluminium. In this way also an alloyed element may intensify corrosion. On the other hand, it is equally possible that the presence of an alloyed metal may improve the protective coating of oxide formed on the surfaces of the metal, and there is good reason to believe that the presence of copper produces this effect to some extent, while the presence of manganese—as has recently been shown—facilitates the formation of a surface "patina" containing manganese oxide as well as alumina.

Even in the best circumstances, however, the protection of light alloys from corrosion is a most important matter, and this is accentuated by the difficulty of finding a suitable paint or varnish the constituents of which do not act upon aluminium—an action which generally takes the form of an interchange of oxygen between the pigment and the metal. Processes for coating the light alloys with a less corrodible metal, such as copper, tin, zinc, &c., have been tried, but these modes of protection are accompanied by the risk of an increased amount of local corrosion owing to galvanic action, if the metallic coating is anywhere broken through. A more hopeful line of thought is to be found in the development of processes for coating the alloys with an adherent layer of some inert compound of aluminium, much as iron and steel are coated with a layer of phosphate of iron in the "Coslettising" process.

Finally, some reference may be made to the possibilities of the use of magnesium and its alloys for the production of light and strong materials of construction. The fact that magnesium has a specific gravity of only 1·74 at once suggests its use for such a purpose, but the fundamental objection lies in the fact that it is much more corrodible than aluminium, and that therefore the attainment of even moderate durability in its alloys must be a problem of much difficulty. That some solution of this problem may have been found is suggested by the statement recently made that the newest German Zeppelin airship is to be constructed of an alloy known as "Elektron," said to be an alloy of aluminium and magnesium. Its density is stated as being close to 1·7, so that it must clearly consist of magnesium alloyed with only 1 or 2 per cent. of aluminium. No data as to the strength of such an alloy are available, but from the known constitution of the alloys of the aluminium-magnesium system, it appears probable that the addition of aluminium to magnesium in proportions up to 7 or 8 per cent. will materially increase the strength of pure magnesium, but the actual results cannot be predicted; it is, however, probable that pure magnesium is rather weaker than pure aluminium, so that it would be surprising to find in this group an alloy having a density less than 1·8, with a tensile strength above 10 or 12 tons per square inch. Alloys of aluminium with small proportions of magnesium are, it may be mentioned, in somewhat extensive use, particularly for certain parts of scientific instruments, under the name of "magnalium," but these alloys, although somewhat lighter, are not so strong as the best of the aluminium-copper and aluminium-copper-manganese series.

From the foregoing review of the question it will be seen that the problem of light alloys is still far from a satisfactory solution, and that there is a need for further systematic study of the alloys of the lighter metals.

WALTER ROSENHAIN.

GREEK ARCHÆOLOGY.[1]

THE "Annual of the British School at Athens" still remains of the somewhat unwieldy size that it has assumed of late years. A return to the more convenient bulk of, say, vol. viii. would be welcomed by the reader; yet it cannot be said of any of the articles in vol. xiv. that any part of them might profitably have been excised. Only the fourth instalment of Dr. Mackenzie's work on "Cretan Palaces" seems rather too long. Still, no doubt the various questions raised by Dr. Dörpfeld's criticism of Dr. Mackenzie's former articles, Dr. Noack's work on Cretan buildings, and the discoveries of Neolithic prototypes of the "Homeric" palace in Thessaly, needed exhaustive treatment. So we are compelled to postpone reading Dr. Mackenzie's views on the relations of the Homeric house to the Cretan palaces until next year.

The director of the school and his assistants continue their account of the discoveries at Sparta, which have conferred such lustre upon British archæological work during the last three years. Few believed that excavations at Sparta would prove so interesting.

1 "The Annual of the British School at Athens." Vol. xiv. (Session 1907–8.) Pp. x+468; 15 plates. (London: Macmillan and Co., Ltd., 1909.) Price 25*s*. net.

We assumed too hastily that the rude, countrified Lacedæmon of the prejudiced and tendencious Athenian historians whom we are taught at school to accept as infallible would yield little or nothing of interest to our spades. Yet the excavations of Messrs. Bosanquet and Dawkins and their helpers have shown that early Sparta was in no way behind other Greek cities in art and civilisation; and we remember that in Homeric days Lacedæmon was a lordly house of princes, while Athens was nothing at all. The excavations of 1909, which are not treated in this volume of the "Annual," have revealed to us the scanty remains of the old Mycenæan civilisation of Sparta, at the Menelaïon, the heroön of Menelaos, on a hill some two miles distant from Sparta itself, on the opposite bank of the Eurotas. We await with interest the publication in the next "Annual" of these discoveries. The volume before us deals chiefly with the continued excavations of the temple of Artemis Orthia, which have resulted in the discovery of the most primitive shrine on the site, which dates from the eighth century B.C. Geometric pottery found beneath its floor shows that the place was sacred at an earlier date, but no Mycenæan sherds prove a history going back into the Bronze age. The geometric sherds lie on virgin soil, and the sanctuary was evidently a new one, established by the Dorians.

The great quantity of pottery found has enabled Mr. Droop to construct a scheme of the development of Laconian pottery from its first stage, immediately succeeding the Geometric, to its latest. The identity of the Laconian style with that hitherto known as "Cyrenian" is proved.

Prehistoric archæology is represented in this volume by two articles by authors who disagree with one another. M. Vassits, the curator of the Belgrade Museum, writes a somewhat inconclusive article on "South-eastern Elements in Prehistoric Servia," in which he claims, reasonably enough, that the Ægean culture must have sent forth a stream of influence which passed up the Vardar valley into the Danubian basin, but does not bring forward much positive evidence of importance to confirm this probability. Messrs. Wace, Droop, and Thompson contribute an account of their very important excavations in Thessaly, which have put into their proper perspective the previous discoveries of Sotiriadis in Bœotia, and Tsountas in Thessaly, and have shown that in early times northern Greece possessed a peculiar art and culture of its own which was very little affected by Ægean influence. We say "very little"; the authors would say "not at all," but without much probability. Mr. Wace and his colleagues have discovered that in northern Greece a Neolithic culture continued to exist until long after the Ægean had reached the full flower of the Bronze age, and that the Thessalian contemporaries of the Minoan Cretans were stone-using barbarians. Then, brushing aside the few traces of Ægean influence on this barbaric culture (such as the rude spiral ornament in the Dimini pottery), they assume that the North-Greek and Ægean contemporary cultures had no connection with one another, and were absolutely independent, not only in origin, but until suddenly the higher culture broke down the lower in the latest Minoan age. It is obvious, however, that this is impossible. The Ægeans were active seamen, and it is incredible that Ægean influence should not have affected the Thessalians, conservative though they were, from the beginning; and, at the same time, that the Ægean influence should not have affected the north coast of the Ægean Sea and have penetrated up the Vardar valley, as M. Vassits says it did, and have greatly influenced the Danubian Bronze-Age civilisation. We believe that the independent North-Greek Neolithic and Chalcolithic "culture" was no bar to this, and that itself it was much more affected by the Minoan culture than its discoverers believe. For us, then, M. Vassits and Mr. Wace are both right.

The great importance of the Thessalian discoveries for the history of the origin of European civilisations is evident. It has never seemed to the present writer probable that the changes from the age of Stone to that of Metal, and from the age of Bronze to that of Iron, each necessarily took place at about the same time all over the European and Mediterranean world; iron, for instance, seems certainly to have been used sporadically by the Egyptians as early as the time of the fourth and sixth dynasties, about 3000 B.C., whereas even in southern Europe it does not appear much before 1000 B.C.; and now we see the same thing in this case of the continued use of stone, for long exclusively, by a large community in northern Greece down nearly to 1300 or 1200 B.C., and contemporaneously with the existence, but two hundred miles off, of the head centre of the splendid Bronze-age civilisation of Minoan Crete. We are again reminded that, though nature *nihil facit per saltum*, human activity does progress in precisely this haphazard way. Our archæologists, too much under the influence of the professors of natural science, have assumed that the evolution of human progress was far more even and equable than actually was the case.

The Greek sculpture of the later period takes up less space in this year's "Annual" than in that of last year; there is only one short article by Mr. Wace on an interesting Pergamene head found at Sparta.

Prof. Burrows and Mr. Ure contribute an account of their excavations in tombs at Rhitsóna (Mykalessos), which have produced large quantities of pottery of the classical period; and there are interesting articles by Mr. Hasluck on the topography of Laconia, and by Mr. Hogarth on Hierapolis Syriæ, the ancient sanctuary between Aleppo and the Euphrates, otherwise called Bambyke or Mabog, the modern Mambij. Mr. Hogarth publishes several fragmentary Greek and Latin inscriptions and graffiti of Roman days from this ancient holy place.

H. R. Hall.

GOATS AND MALTA FEVER.

A QUESTION asked in the House of Commons on June 13 illustrates the desirability of members of Parliament becoming familiar to some extent with scientific facts before concerning themselves with subjects in which such facts are involved.

The question was in regard to the part played by the goat in the spread of Malta fever, and arose out of a misreading of the evidence given before the Royal Commission on Vivisection (Q. 14,242). The question asked was to the effect that, seeing no goats had been infected by the alleged Malta-fever germ, and that it did not give rise to any ill-health or fever in these animals, why spend money on any inquiry regarding the part played by goats in Malta fever?

The evidence given before the Royal Commission was that the goats did suffer from this disease, that the micro-organism did multiply in their bodies, but that it did not give rise to any appearance of ill-health or rise in temperature. It is this that makes the goat so dangerous. If Malta fever caused high fever and the other symptoms of a severe disease in the goat, as it does in man, the goat would probably cease to be a danger. The animal would be confined to its stable, and its milk would run dry. As it is, the goat which acts as a source of the virus of Malta fever continues to accompany the herd into the town or village, appears the picture of health, and secretes quite as much milk as its harmless neighbours.

This is a matter of great practical importance, since the Maltese themselves refuse to believe that Malta fever is milk-borne, although the Commission sent out in 1904–5–6 to investigate the disease proved this up to the hilt. Since then the Maltese have been exporting their Malta-fever-carrier goats, and spreading this serious human disease far and near. That this should be permitted would seem to be beyond belief, but, looking nearer home, we must remember that our own milk supply is not quite free from the tubercle bacillus.

The American Government attempted to import Maltese goats in 1906. The drinking of the milk of these gave rise to an epidemic of Malta fever on board the vessel which conveyed them from Malta, and a woman in the quarantine station in America became infected. The sequel to this story is told in a recent report of the Board of Agriculture of America. The goats remained under strict quarantine and inspection for some two years, those showing marked infection with Malta fever being slaughtered from time to time. The result is that all the animals imported have been slaughtered—even the kids born in America—not a single animal could be saved, on account of Malta-fever infection.

This disease is becoming more widespread every year. Last year the Sleeping Sickness Commission of the Royal Society discovered an epidemic of it affecting a large part of the native population round the shores of Lake Albert Edward, in the south-west corner of Uganda, and the native goats in that out-of-the-way place were found to be the carriers, just as in Malta.

In regard to the result of forbidding the use of goats' milk to the sailors and soldiers in Malta, it cannot be too often repeated that this simple order at once led to the extinction of the fever in the garrison. This does not, of course, refer to the native population, among whom the incidence of the disease is as great as ever. In 1905, before the preventive measures came into operation, there were 643 cases in the Army alone; in 1906, 147; in 1907, 11; in 1908, 5; in 1909, 1; in 1910, 0.

THE KING AND THE ROYAL SOCIETY.

Among the addresses received by the King at St. James's Palace on June 9 was one from the Royal Society, which was presented by a deputation consisting of Sir Archibald Geikie (president), Sir Andrew Noble (vice-president), Mr. A. B. Kempe (treasurer and vice-president), Sir Joseph Larmor and Prof. J. R. Bradford (secretaries), and Sir William Crookes (foreign secretary), with Mr. R. Harrison (assistant secretary) bearing the mace.

In the course of the address it was stated :—

We are proud to remember that no less than forty-seven years ago King Edward was graciously pleased to enter the Fellowship of the Royal Society, and later, on his accession to the Throne, to become our Patron.

Your Majesty enters upon the duties of your high station with a wider personal knowledge of the Empire and its various peoples than was ever possessed by any previous Sovereign of this country. Your subjects have had many proofs that this extended knowledge has been accompanied by an active sympathy with every cause and movement that will promote their welfare and happiness. The interest which your Majesty has shown in the progress of discovery and invention assures us that these elements of national greatness will continue to receive your favour and protection.

His Majesty replied as follows :—

I thank you for the loyal address of condolence from the president, council, and Fellows of the Royal Society on the death of my beloved father. It is a consolation to feel that your society, numbering amongst its fellows the most distinguished men of science of this country, sympathises with me in my terrible bereavement.

Your words of appreciation of the character of the late King are very welcome to me. He always regarded with the deepest interest those scientific discoveries, and those applications of discoveries already made, which have been of such supreme importance in the advancement of civilisation. I also have watched with close attention the work of your society, and it is my sincere hope that its prosperity will continue, and that a Fellowship of the Royal Society will always be esteemed one of the highest honours which can be earned by devotion to the cause of science.

I desire to thank you most cordially for your congratulations on my accession to the Throne, and to assure you of my sympathy and support in your beneficent efforts for the promotion of natural knowledge. I gladly accede to your request that I should inscribe my name as Patron in your charter book.

PROF. GEORGE F. BARKER.

Prof. Barker, whose death was announced last week, was one of the most genial men of science on the other side of the Atlantic. He was a frequent visitor in London, and invariably of recent years, during the period of his stay, he was made an honorary member of the Athenæum. He was born in Charlestown, Mass., in 1835, and died on May 25 last. He was educated in the Boston public schools, finishing at Yale, where he graduated in 1858.

The American system of education is continuous and methodical, and whatever line of pursuit an American boy is prepared for, he is ultimately turned out well drilled for his future career. Barker commenced in the Albany Medical College, where he received the degree of Doctor of Medicine in 1863, and was appointed professor of chemistry at Wheaton College, Illinois. Thence he proceeded to the Western University of Pennsylvania in the same capacity, but later he became professor of physiological chemistry and toxicology. In 1872 he was appointed professor of physics at the University of Pennsylvania, in Philadelphia, and there he taught until 1900, when he retired on account of ill-health.

Prof. Barker was an admirable teacher and expounder, but he did not undertake much research, and therefore his name is not so well known in the scientific world as that of many of his countrymen. He was much engaged as an expert witness, especially in patent cases. He acted as United States Commissioner to the Paris Electrical Exhibition of 1881, to the Electrical Exhibition held in Philadelphia in 1884, and he took a very prominent part on the jury of the electrical department of the great exhibition in Chicago in 1893. He was a past president of the American Chemical Society and of the American Association for the Advancement of Science. He had served as vice-president of the American Philosophical Society, the headquarters of which are in Philadelphia, since 1899. His English friends will miss him very much when they visit America.

NOTES.

Sir John Gavey, C.B., will deliver the James Forrest lecture at the Institution of Civil Engineers on June 22. The subject will be "Recent Developments of Telegraphy and Telephony."

A conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, South Kensington, on Tuesday, June 28.

Prof. T. W. Richards has accepted the invitation of the council of the Chemical Society to deliver the Faraday lecture of the society next session.

The death is announced, at the age of eighty-four years, of Prof. W. P. Blake, emeritus professor of metallurgy, geology, and mining, and director of the School of Mines of the University of Arizona.

A correspondent says he "would like to ask Messrs. Cowell and Crommelin whether it is not highly probable that the Star of Bethlehem was, after all, nothing else than Halley's comet"? We submitted the inquiry to Dr. Cowell, who has been good enough to reply that he does not consider it "highly probable" that the two objects are identical.

It is proposed to establish, under the title of the India Society, an association to promote the study and appreciation of Indian culture in its æsthetic aspects. The new society will publish, for distribution to its members, works showing the best examples of Indian architecture, sculpture, and painting, and will assist in the preservation of the traditional arts and handicrafts of the Empire. The honorary secretary is Mr. T. W. Rolleston, Ardeevin, Christ Church Road, Hampstead, N.W.

The National Association for the Prevention of Consumption is inaugurating an educational campaign against tuberculosis. So great has been the success of the Travelling Tuberculosis Exhibition that the council is convinced that the time has come for a vigorous and widespread effort. A special appeal committee has been appointed, over which the Earl of Derby will preside, to raise funds. Its object is to raise an annual income of 5000*l.* for the purpose of spreading information on the question of the cure and prevention of consumption. This campaign is to be carried out by means of travelling tuberculosis exhibitions; caravans, with lantern-slides, for small towns and villages; popular lectures; an information bureau; and the distribution of literature. The cooperation of all persons is solicited to aid in raising the fund, which will be applied entirely to educational purposes, as the committee feels that if the country can be aroused to a comprehension of the loss in life and money occasioned by tuberculosis, and the methods by which the disease can be controlled, ultimate conquest is assured.

The Italian earthquake of June 7, referred to last week, occurred in a district which is frequently disturbed by shocks from more or less distant centres, but in which they rarely originate. Avellino, where the recent shock was strongly felt, is thirty miles east of Naples. The epicentre of the earthquake was, however, about thirty miles still farther to the east, including the villages of Calitri and San Fele, at both of which there was much damage to property and some loss of life. The only important earthquake which is known to have occurred in the same centre is that of September 8, 1694, when more than four thousand lives were lost. Calitri was then entirely destroyed, and at least 700 persons were killed. The epicentre of both earthquakes lies only a few miles to the north-west of that of the great Neapolitan earthquake of 1857, and not far from the continuation of the isoseismal lines drawn by Mallet in his well-known report.

Prof. Ronald Ross, in an address to representatives of the missionary societies of the world meeting at Livingstone College on Commemoration Day, June 11, urged that missionaries, like the priests of old, should be healers both of the mind and of the body. He suggested that missionaries might ascertain, by the examination of the spleen, whether children in the tropics were affected by malaria, and that this would give a rough indication of the amount of malaria in the district. He suggested that quinine might then be administered to the children in the district, and that this would tend to check the spread of the disease. He also hoped that they would be able to assist in drainage schemes, so that the breeding places of mosquitoes might be eradicated. He thought all missionaries should have such training as that given at Livingstone College, in order to be enabled to share in these sanitary precautions.

Many meteorologists will be glad to learn that the activity of the British Rainfall Organisation, founded some fifty years ago by the late Mr. G. J. Symons, has been placed upon a permanent footing by the transfer of the management by the director, Dr. H. R. Mill, to a strong representative board of trustees interested in rainfall work. The board will consist of Dr. Mill (as chairman), Mr. F. Druce (treasurer), Mr. R. M. Barrington, Sir Alexander Binnie, Mr. C. L. Brook, Mr. C. J. P. Cave, Mr. D. W. Freshfield, Dr. H. Mellish, Sir John Murray, and Mr. J. G. Wood. The board, with the aid of other obeservers, will form an endowment fund for the continuance of the work, which hitherto has been dependent on the efforts of its promoters and voluntary contributions. The observers now number nearly 5000, and the accumulated records are quite unique. Dr. Mill now makes over the whole of the documents and the lease of the headquarters in Camden Square to the board of trustees as a free gift for the benefit of meteorological science.

The fifteenth annual congress of the South-eastern Union of Scientific Societies was held at Guildford from June 8 to 11. Dr. D. H. Scott, F.R.S., was succeeded as president by Prof. Ernest Gardner, who delivered a discourse on the evolution of classical art. Some of the papers read were of much local interest, notably one by Mr. H. Bury on the relation of the River Wey to the Blackwater and the Arun—a study of river-development on the lines laid down by Prof. W. M. Davis. Another local paper dealt with the Pilgrims' Way between Farnham and Albury, in which Mr. J. G. N. Clift discussed the question whether the route was along the higher or the lower road. Mr. E. A. Martin explained his experiments on dew-ponds, made with the view of determining the way in which the supply of water was maintained. Dr. W. Martin showed in a learned paper how the bird's-eye views and maps of the sixteenth and seventeenth centuries should be interpreted. A lecture on colour in insects was given by Mr. J. W. Tutt, in which he pointed out the need of obtaining definite information respecting the changes which bring about differences of coloration. Dr. Vaughan Cornish lectured on waves in sand and snow, and Mr. A. R. Horwood, of Leicester, referred to the extinction of cryptogams. The Rev. R. Ashington Bullen is succeeded as honorary secretary of the union by Dr. William Martin, who will be assisted by Mr. Norman Gray. Next year's congress will be held at St. Albans, under Sir David Gill, K.C.B.

The University of California, continuing the investigation of the numerous shell-mounds on the shores of San Francisco Bay, publishes in the fifth part of vol. vii. of its Proceedings a report on that at Ellis Landing, by Mr. N. C. Nelson. This is one of the largest of the series, and the period required for its accumulation is estimated at more than three thousand years. From the very beginning it was used both as a dwelling site and place of burial, and it was occupied by the Californian aborigines up to a time not long antecedent to the European discovery and occupation of the country. The earliest occupants were not savages of the lowest grade, and there is throughout the strata distinct evidence of the evolu-

tion of culture. The later inhabitants were skilled in various industries, and made journeys to, or had trade relations with, distant tribes. Even if it was from time to time occupied by migrants or enemies, these people were all essentially of the same type, and the last were Indians similar to the inhabitants of Middle California within historic times.

Messrs. Dulau and Co. have published part iv. of the "Treasury of Human Inheritance," the publication containing pedigrees, illustrative of the inheritance of various defects or other characters, issued by the Galton Laboratory for National Eugenics. The present part contains pedigrees of a large number of cases of hare-lip and cleft palate, with introductory explanation and bibliography by Dr. H. Rischbieth; pedigrees of hereditary deaf-mutism collected by the Eugenics Laboratory; and pedigrees of congenital cataract, collected and annotated by Mr. N. Bishop Harman. The pedigrees are given in the same general style as in previous parts, and the first and third articles are illustrated by a number of plates, which are exceedingly well reproduced.

Mr. M. Oshima, of the Bureau of Scientific Researches at Taihoku, has been enabled to add twelve species to the twenty-nine recorded in Stejneger's "Herpetology of Japan, &c.," as indigenous to Formosa. Of these twelve additions, four species and one subspecies are regarded as new to science. Mr. Oshima's paper appears in vol. vii., part iii., of *Annotationes Zoologicae Japonensis*, which also includes four articles on as many groups of Japanese invertebrates.

To the June issue of Witherby's *British Birds* Mr. H. Wormald contributes an exquisitely illustrated article on the attitudes assumed by the mallard and certain other drakes during the period of courtship. The performance generally commences by four or five mallards swimming round a duck with their necks drawn in, and then suddenly lowering their beaks, and at the same time raising themselves nearly upright in the water and drawing the beak up the breast. For the other actions we must refer the readers to the paper itself, as they are difficult to describe.

In their thirty-eighth report (1909–10) the directors of the Zoological Society of Philadelphia state that in December last a large number of animals collected by the Smithsonian Institution expedition to East Africa, under Mr. Roosevelt, were temporarily accommodated in the gardens previous to their transport to the National Zoological Park at Washington. Specimens of Thomson's gazelle, waterbuck, Coke's hartebeest, and wart-hog became, however, the property of the society. The last-named species, we regret to see, figures in the list as Macrocephalus in place of Phacochœrus. When a name fits an animal so admirably as the latter does the wart-hog, it ought in no circumstances to be changed.

We have to acknowledge the receipt of the report of the director of the Zoological Gardens at Giza, near Cairo, for 1909, in which it is stated that the season under review was unusually favourable to the animals, although the number of visitors was 26,239 less than in the previous year. To the late and present Governors of Senar the gardens were indebted for a large and representative collection of animals fom the Blue Nile, while a feature of the year was the large number of species which bred in the menagerie. Jungle-cats and foxes were responsible for the deaths of several animals, while to rats, owls, &c., may probably be attributed the disappearance of many others.

In past years locusts have caused enormous losses in South Africa to the farmers, who have usually, on religious grounds, taken no steps to destroy them. Since agricultural departments have been formed, locust officers have been appointed whose duty it is to collect information about the swarms and the places where eggs are laid, and to take such destructive measures as may be necessary. The report of the chief officer for Cape Colony for the past season has recently been issued in the *Agricultural Journal of the Cape of Good Hope* (No. 2, 1910). The most successful method of destruction is to spray the veldt with a dilute solution of sodium arsenite and treacle, or, if the grass is too short, to scatter some finely chopped green vegetation, bran, or even "voetgangers" themselves, previously soaked in the solution. When the swarm comes along it is immediately attracted by the treacle, and eats with great voracity, so that the insects soon begin to sicken and die. It is even recorded that a second swarm has come up and devoured the first, two swarms thus perishing through one spraying. At an earlier stage the destruction is a simpler matter—the insects are sprayed immediately they hatch out. Wherever these methods are adopted damage from locusts becomes comparatively small, and as soon as the religious scruples of the farmers can be overcome and adequate help is rendered, the locust plague will cease to be formidable because it can be controlled.

Mr. E. Heron-Allen, writing from Large Acres, Selsey, sends an account of the extraction of several colours by him from purple iris flowers. The petals of from twenty to thirty flowers of the deep purple iris, which were either quite withered (shrivelled, but still moist) or just beginning to wither, were put into a jar and just covered with alcohol. At the end of ten minutes, (1) a bright and typically iris reddish purple solution was produced; (2) these soaked (in alcohol) blossoms, squeezed fairly dry and steeped in plain cold water for ten minutes, gave a bright ultramarine-blue solution, with no trace of purple or red; (3) these alcohol-soaked blossoms, left in the water for an hour, gave a deep (almost indigo) blue solution, with no trace of purple or red. Another similar lot of blossoms, cut just above the seed pod, were steeped in enough alcohol to cover them, for three hours, and gave a rich crimson solution with no trace of blue or purple. Several other brilliant and distinctive colours were obtained by various treatments of blossoms and residues. Mr. Heron-Allen's interesting observations remind us that while we have in this country a wide range of blue and red, as well as of yellow flowers, there is not, with the exception of woad (*Isatis tinctoria*), a single indigenous blue, or even red, colouring matter which has ever been of any importance as a dye-stuff. Many years ago woad was used to some extent as a source of indigo, while weld (*Reseda luteola*), dyer's-broom (*Genista tinctoria*), and many other yellow dyes were also employed, but we were dependent upon foreign countries for our colouring matters even when natural dye-stuffs were used. The chemical constitution of the colouring matter of the purple iris does not appear to have been investigated, but the results obtained by Mr. Heron-Allen may probably be explained by the extraction of traces of acid and alkaline bodies by the solvents used.

Mr. Johs Schmidt, head of the recent Danish expedition in the *Thor* for the investigation of physical conditions in the Mediterranean, has sent us a reprint of a preliminary report on the work of the expedition, published in *La Géographie*. The *Thor* cruised in the Straits of Gibraltar and along the north coast of Africa to Sardinia, then

explored the western Italian coast, and made some observations further east in the southern Adriatic and off the coast of Greece. The results are of great value and interest. Special attention may perhaps be directed to the section of the region west of the Straits of Gibraltar made between February 20 and 28, 1909, which may be compared with a similar section based on Dr. Wolfenden's observations made in the *Silver Belle* in 1904.

In the *Sitzungsberichte* of the Vienna Academy of Sciences of December 9, 1909, Prof. W. Trabert discusses the connection between the temperature conditions of the atmosphere and the pressure at the surface of the earth. The inquiry is based upon observations of the temperature of the upper air during 1903–8 made by the aëronautical observatory at Lindenberg, and on the simultaneous behaviour of the barometer at the ground level. For this purpose those days were selected on which the air-column over Lindenberg was colder than the previous and following days, and *vice versa*. The results show, *inter alia*, that the barometer rises during the existence of cold air-columns; the minimum of pressure occurs generally on the day before, and the maximum on the day following. With warm columns of air the reverse holds good. After an extreme of pressure a column of extreme temperature occurs as a rule on the first or second day afterwards, viz. a warm column follows a high pressure, and *vice versa*. There is, at all events, an intimate connection between temperature conditions in the free air and pressure at the ground level, from which fact the author agrees with the opinion generally obtaining at the present time, that "the hope of meteorology lies in the upper regions."

An extended series of tidal observations on the Pacific coast was obtained by the Canadian Tidal Survey during the summer of 1909, under the supervision of Dr. W. Bell Dawson, the superintendent of the Survey. There were in all a series of twenty recording tide-gauges in simultaneous operation along the coast of British Columbia. One noteworthy result obtained is that the time of high and low water at the head of the long inlets on the coast is very little later than at the mouth. For instance, at the head of Bute inlet high water is only seven minutes later and low water fourteen minutes later than at Lund, sixty-six miles below. The range of the tide at the head of the other inlets is only from 2 to 12 per cent. greater than at their mouth. This rapid progress of the tidal undulation must be due to the great depth of such inlets. Where the depth is so great, the whole surface of the inlet rises and falls simultaneously, in correspondence with the impulse at its mouth given by the rise and fall of the tide in the open. It would also appear that there is little current except in the mouth of the inlet, where the pulsation takes place. The results obtained by Dr. Dawson provide valuable information upon the subject of the progress of the tide in ordinary shallow estuaries and in deep inlets. They are in no sense, therefore, of merely local interest or local application, but they illustrate the general question of the rate of progress of the tide relatively to the depth of the channel or inlet.

The velocities of certain reactions between metals and the halogens in solution form the subject of a paper by Messrs. R. G. van Name and Graham Edgar in the current number of the *Zeitschrift für physikalische Chemie* (May 24). Solutions of iodine and bromine in potassium iodide and bromide solution respectively were allowed to react with mercury, cadmium, zinc, copper, and silver at 25° C. and 35° C., and the velocities of solution of the metal measured. With iodine the velocity of solution was found to be practically independent of the nature of the metal. The temperature coefficient of the reaction was found to be unusually low, about 1·3 for 10° rise, instead of 2·0 generally found for reactions in homogeneous systems.

Special interest attaches to a paper by the late Dr. Ludwig Mond on "Some New Metallic Carbonyls," which appears (with an introduction by Dr. R. L. Mond) in the Journal of the Chemical Society. A description is given of the apparatus, by means of which the action of carbonic oxide on metals could be tested at temperatures up to 450°, and at pressures up to 500 atmospheres. An account is also given of a new black cobalt carbonyl, $Co(CO)_3$, prepared by the decomposition of the red tetracarbonyl, $Co(CO)_4$, recently described, of a ruthenium carbonyl, of which only a small quantity was obtained as an orange-yellow deposit, and of a molybdenum carbonyl, $Mo(CO)_6$, forming highly refractive white crystals which sublime without melting in an atmosphere of hydrogen or carbon monoxide at 30° to 40°.

Prof. H. B. Dixon's presidential address to the Chemical Society, reproduced in the Society's Journal, deals with the "Union of Hydrogen and Oxygen in Flames." He considers that the explosion of the two gases is a direct action, (1) because well-dried mixtures of electrolytic gas always explode with a spark; (2) because the velocity of explosion in a well-dried mixture is greater than when steam is added; and (3) because the explosion-wave is propagated exactly in the same way as a pressure-wave in the gas. In the case of the combustion of the gases at moderate temperatures, he agrees with Dr. Baker that steam plays an important part in the interaction of the two gases, but suggests that if once a flame is started the presence of moisture is not necessary for its propagation. During the combustion small amounts of hydrogen peroxide are formed, which can be preserved by allowing the jet to impinge on ice or on solid carbon dioxide. It has been suggested that hydrogen peroxide is the first product of the interaction, and this view has been supported on various grounds, as, for instance, on the ground that the primary interaction in a gaseous mixture must be between two molecules only. For these views no sufficient support appears to be forthcoming, and many of the arguments used in its favour are shown to be fallacious.

The idea first expressed by Lord Rayleigh, and afterwards by Prof. Liebenow, that the high electrical resistivity of alloys was due to thermo-electric forces set up at the points of contact of the constituents of the alloys, has been taken up by several physicists, but no attempts to establish its truth experimentally have succeeded. In the *Physikalische Zeitschrift* for May 15 there is a communication from Mr. K. P. Brooks which appears to prove definitely that the idea is untenable. Mr. Brooks has measured the resistivity at different temperatures of columns consisting of a large number of thin gold and silver discs, and of sticks of compressed gold and silver dust, and has found that their resistivity and their temperature coefficient of resistivity lie between those of their constituents, and vary with composition according to the ordinary law of mixtures. Alloys of the two have, on the contrary, higher resistivities and lower temperature coefficients than have their constituents.

In the *Revue générale des Sciences* of April 30 Prof. E. Cohen, of the University of Utrecht, writes of what he terms the "infectious diseases of metals." Under this heading he describes systematic observations on the allo-

tropic transformation which metallic tin undergoes at moderately low temperatures. More interesting, because of far wider importance, however, are his observations and views on what he terms the "maladie d'écrouissage"; this is, in reality, simply a process of spontaneous annealing or re-crystallisation which occurs in certain circumstances in metals which have been severely hardened by plastic strain. So long ago as 1900 Ewing and Rosenhain showed that when pure lead has been freshly crushed or rolled, the minute crystals commence to grow, even at the ordinary temperature, at a rate which produces visible changes in a few weeks. Prof. Cohen's observations show that processes of this kind are not confined to lead, but occur also in harder materials, especially in hard-drawn brass, thus accounting for the spontaneous cracking of cartridge-cases which occasionally occurs in practice after a lapse of several years from the date of manufacture, on the view that the re-crystallisation process is accompanied by a change in volume. The whole process is favoured by any rise of temperature, so that the phenomena are more readily observed in hot climates. Whether such action takes place at possibly a still slower rate in iron and steel is a problem still to be investigated. An important fact brought out by Prof. Cohen's experiments, however, is that the process of re-crystallisation is initiated and accelerated by intimate contact with a piece of the same metal in the stable or "annealed" condition; it is, indeed, this phenomenon which leads Prof. Cohen to describe the whole process as an "infectious disease" of metals.

THE *Engineer* for June 3 contains a description of the Druitt Halpin system of thermal storage recently installed at the King's Road works of the St. Pancras Borough Council Electricity and Public Lighting Department. Each of four water-tube boilers has been fitted with a storage vessel, and some figures regarding the performance of the plant are certified by Mr. Baynes, the borough electrical engineer. Each boiler, as originally installed, had a maximum normal evaporation of about 11,000 lb. per hour. One boiler fitted with a thermal storage drum was run for 2h. 51m., the storage drum being full at the start and empty at the finish. During this time the average evaporation per hour was found to be 17,542 lb., or an increase of 59·5 per cent. more than the normal. During this test the average working pressure was 185 lb. per square inch, the temperature in the drum 360° F., and the draught at the boiler exit 0·5 inch by water-gauge. With this system it is found that deposits from hard water are found in the storage drum rather than in the boiler, and are therefore not subjected to the heat of the furnace, which would bake them to a hard scale. Such deposits are very easily blown off from the storage drum in a soft powdery state.

MESSRS. LONGMANS, GREEN AND CO. have published a third edition of Dr. F. Mollwo Perkin's "Qualitative Chemical Analysis: Organic and Inorganic." The first edition of the work was reviewed in our issue of August 22, 1901 (vol. lxiv., p. 397), and it is sufficient to point out that to the present issue has been added a short section dealing with some of the rarer elements and a new chapter on ethereal salts.

A THIRD edition of Mr. Walter B. Priest's "Scheme for the Promotion of Scientific Research" has been published by Messrs. Stevens and Sons, Ltd. We dealt with the second edition somewhat fully in our issue of January 21, 1909 (vol. lxxix., p. 345). In the present edition the administration of grants has been further explained, and the author of the book proposes terms of allocations of grants in relation especially to electrical science. The author hopes that the advantages to be gained by legislating for the promotion of scientific research, where it affects purposes of general utility and advantage, will receive serious consideration.

OUR ASTRONOMICAL COLUMN.

THE METEOR OF JUNE 1.—Further observations of the large meteor of June 1 9h. 40m. have been received by Mr. Denning from various parts, and they are in very fair agreement with each other and with the values given by him for the height, radiant, &c., in NATURE for June 9.

The meteor was seen from Clapham Common passing from a few degrees below the pointers in Ursa Major to a place just north of "The Twins." The trail was a reddish-yellow colour, while the nucleus was a brilliant electric-blue. At Loughton, Essex, the meteor was viewed during a portion of its flight over the western sky. The object appeared extraordinarily brilliant, with a blue head and red tail.

As an instance of the erroneous impressions of nearness occasioned by the startling lustre of fireballs of this kind, it may be mentioned that the observer at Loughton estimated it as seventy yards distant, and thought it must have fallen behind a house near him. Search was made for fragments, but without avail. As a matter of fact, the meteor was more than 100 miles distant. The shower of Scorpiids to which it owed its origin is singularly rich in fireballs in June, and they form probably the débris of some dissevered, periodic comet the materials of which are now distributed into a wide stream.

COMING TOTAL ECLIPSES OF THE SUN.—From Dr. Pio Emanuelli we have received an abstract from the *Rivista di Astronomia e Scienze affini* (April) in which he discusses in detail the conditions of the total solar eclipses of the sun on May 9, 1910, April 28–29, 1911, and April 17, 1912. The eclipse of 1911 will have a period of totality of nearly five minutes, and the line of totality will completely traverse the Pacific Ocean; commencing on the east coast of Australia, it will terminate at a short distance from the west coast of Central America. A small chart given by Dr. Emanuelli shows the path of the shadow touching the islands of Nassau, Samoa, and Tonga. Vavau Island will probably afford the best *locale* for observations, and at the port of Neiafu, on the south-west coast, totality will last for 3m. 36·8s. with the sun at an altitude of 43°. At Tau, in the Samoan archipelago, totality will endure for 2m. 13s., the altitude being 51°. The last island to be traversed by the shadow will be Nassau, which is practically an uninhabited desert 1280 metres long and 914 metres across; but here the duration of totality will be 4m. 10s., and the altitude of the sun 57°.

THE NEW CANALS ON MARS.—In No. 422 of the *Observatory* (p. 215) M. Jonckheere states that, from observations made at Hem, there can be no doubt as to the reality of the two new canals recently described by Prof. Lowell. Independent observations by M. Jarry Desloges and himself disclosed these features, which were carefully studied at the Hem Observatory.

THE OBJECTIVE-PRISM DETERMINATION OF STELLAR VELOCITIES.—In No. 4, vol. xxxi., of the *Astrophysical Journal* Prof. R. W. Wood reports further progress in the preparation of light-filters for use in the objective-prism, radial-velocity work recently described by Prof. E. C. Pickering. It will be remembered that by employing a neodymium-chloride filter, Prof. Pickering introduced a fine absorption line into the spectra to which the stellar lines could be referred for measurements of velocity in the line of sight. Prof. Wood now finds that the addition of erbium chloride introduces another good reference line at λ 382, whilst, with isochromatic plates, the narrow interspace between two neodymium bands at λ 5220 might be employed. With vapours he believes better results could be obtained, and he is also experimenting on the manufacture of solid screens by using a solvent which would solidify, such as styrol. The success attained so far is very promising for the final application of this method.

EXPLORATION OF THE KARAKORAM RANGE.[1]

IN the communication referred to below H.R.H. the Duke of the Abruzzi gives a very interesting account of his expedition last summer to Baltistan, in Kashmir territory, undertaken with the object of ascending K2, the highest peak in the N.W. Himalaya, as well as to investigate the physical features of that range, which his previous mountain work in North America and Africa would render so valuable by comparison.

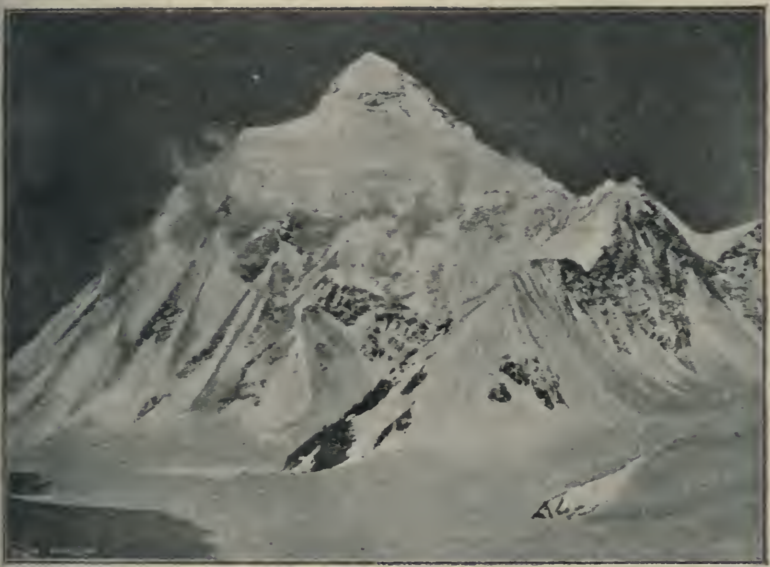


FIG. 1.—The Peak K2 from Windy Gap.

The rapidity and facility of modern-day travel compared with that of fifty years ago is remarkable. From Srinagar to the foot of the Baltoro occupied only fifteen days, which in 1861 took me twenty-nine. The Duke proceeded *via* the Indus Valley and the Braldoh River, and returned by the Skoro La and the Deosai Plains, all now well known and constantly travelled over.

The Baltoro Glacier has since 1861 been made famous by the visits of no fewer than three exploring parties, commencing in 1892, who have added to the topographical detail of its furthest sources. This last expedition was large and well equipped; besides its leader, there were the Marquis F. Negrotto, Messrs. Vittorio Sella, F. De Filippi, three Italian guides, G. Petigrew and A. and E. Brocherel, four porters and an assistant photographer, and Mr. Baines, who joined the party in Kashmir to look after the transport arrangements, so that the number of porters proceeding from Askolay was about 360. On May 18 they began the ascent of the great glacier, the first camp being at Liligo, on the right bank, where the marginal ice cliff is mentioned as being 196 feet high. The next day Rdokas, on the same side, was reached, where the party were detained three days by bad weather, snow falling and covering the surface of the glacier. This was made the base-camp. The magnificence of the view to the north from this point of the gigantic peaks and spurs of the main range, of which one, now known as Mustakh Tower, is the most striking feature, is described.

Beyond this camp reference is made to, and a hypothesis ventured on, a very conspicuous feature (mentioned in my paper, "The Glaciers of the Mustakh Range," R. G. Soc., January, 1864)—the long line of white ice in masses more or less detached, and distinct in structure from that of the ice on either side. I was unable to follow this ice-flow to its source. I venture yet another hypothesis. Its position is central; it appeared to originate from the precipitous western face of Gusherbrum, and to be glacial ice quite free from any morainic matter drawn into the flow of the main northern and southern branches, but had never been subjected to the pressure and formed under the same conditions as the ice which carried and partly held it in position. This is only one of the phenomena connected with these great glaciers awaiting elucidation and calling for that closer investigation which the first explorers had not the time to solve.

On reaching the base of K2 a close examination of the peak was made, first on the western side up the tributary glacier named Savoia, leading to the saddle at its head, 21,863 feet. It was a stiff climb; steps in the ice had to be cut all the way up to the summit. The Tibetan side presented a precipitous wall of rock; beneath was a glacier flowing west to the Oprang Valley, probably a tributary of the glacier descending from the Mustakh Pass. As the Duke describes it, the northern flank of K2 seen from that side must form a gigantic wall nearly 10,000 feet in height. Seen well from here, K2 was deemed impracticable for the Alpine climber. The explorers next attacked the eastern side, and reached the points attained by the Anglo-Austrian expedition. From this splendid Alpine basin, as it is described, K2, with its precipices and snow cone, shows itself in all its splendour; the difficulties of its ascent were apparent, and they had to declare themselves conquered—that only in an aëroplane could the summit be reached. From the

FIG. 2.—The Bride Peak.

[1] *Bollettino della Società Geografica Italiana*, April, 1910. Esplorazione nei monti del Karakoram. By S. A. R. Luigi Amedeo di Savoja, duca degli Abruzzi. Con due carte e 5 illustrazioni fuore testo.

water parting on this side they saw a precipitous slope on the Tibetan side, not vertical as at the Sella Savoia, but a very crevassed glacier. The Italian guides and porters might have descended, but returning was the difficulty. The Duke was under the impression they would see from here the Oprang Valley; however, he was surprised to find a great glacier flowing south-east, separating Windy Gap from a great mountain chain which appeared to connect with Staircase Peak on the north; this glacier received numerous tributaries from the eastern face of the Staircase and mountains south of Windy Gap. The Duke says that here are two important geographical problems to be resolved—how the chain is attached to Staircase Peak and where the glacier the travellers saw emerges. From Windy Gap and Sella Vittoria Sella the eastern peaks of Gusherbrum were seen, and the Duke suggests that the glacier from there and the Staircase was the one seen by Younghusband from the Oprang Valley. A most plucky attempt was made by the Duke and two porters to reach the top of Staircase Peak, but after a night at 21,650 feet they were baffled by a *bergschrund*, which they failed to work round. From here K2 appeared more than ever inaccessible; it is recorded, also, that its northern face is precipitous, also that towards the east chains and mountains were lost in the distance.

Rejoining his party on June 28, the Duke determined to make a final effort to ascend the Bride Peak (K6), 25,119 feet. Ascending the main Baltoro glacier, from Footstool Camp of Conway, on July 3, he and Sella started for the Kondus Saddle; the view they obtained from this point, 20,772 feet, compensated them for all they had gone through. To the south it lay over the Kondus Glacier, embracing Peaks K7, K8, and K9; he noted that this valley trends to the east, then bends to the north, coming round Golden Throne and Hidden Peak, and perhaps joins the pass at the head of the Ordoch Glacier of Younghusband.

Although the work was most severe and many camps were in exposed and trying sites, great praise is due to all, and the account is written in a most natural, unpretentious way. The value of the Italian guides on work of this nature is well exemplified, for when they were on the Chogolisa Saddle, and Sella had left for Rdokas, they prevailed on the Duke to wait for fine weather and attack the "Bride Peak," and the little party actually stayed three weeks on this exposed ridge of 21,000 feet.

The ascent was finally made, and a point 24,577 feet reached, close below the summit, when, dense mist coming on, and the remaining 500 feet being of a dangerous nature, they reluctantly had to descend, having attained the highest altitude yet reached by man. More it was impossible to do. The Duke trusts some future traveller, profiting by his labours, may some day reach the magnificent summit of the Bride Peak (Fig. 2). The future surveyor who may be sent there is taught a valuable lesson by these most capable mountaineers towards the securing of an accurate plane-table survey of the wonderful unknown country lying to the eastward. With the numerous peaks fixed by the triangulation, it is shown conclusively that the area occupied by the Terim Gangrhi and glacier, together with the Snowy Range from which the Remo Glacier descends, could all be mapped and dozens of peaks fixed from points already visited by the Duke of the Abruzzi and Dr. Longstaff, supplemented by a few others at the head of the Kondus Valley and those seen from the Mustakh Pass crossed by Younghusband.

H. H. Godwin-Austen.

FURTHER OBSERVATIONS OF HALLEY'S COMET.

A NUMBER of further observations of Halley's comet are recorded in Nos. 4415–8 of the *Astronomische Nachrichten*. In No. 4416 (p. 401) Prof. Max Wolf gives a sketch showing the position of the tail on May 12 at 14h. 15m. (Königstuhl M.T.). A slight curvature was noted, the convex side being towards the north, and the extremity of the tail lay on a line joining α Equulei and β Aquarii. From this observation it was deduced that the actual length of the tail was about 45 million kilometres (28 million miles), whilst that part through which the earth would pass, if passage took place, was at least 3° broad. Observations extending from May 17 to 24 indicate that the halos observed at the Königstuhl Observatory on May 19 were more than twice as strong as those observed on the other days. Dr. Cerulli directs attention to an apparent shortening of the tail towards 15h. (M.E.T.) on May 18, which he ascribes rather to the alteration of direction, in regard to the line of vision, than to the approach of daylight.

Herr A. Miethe records that, at the photographic observatory of the Royal Technical High School, Berlin, on May 24, the nucleus of the comet was seen to occult the 8·5 magnitude star A.G. Lpz. I. 4615; for 28·1 seconds the star was lost in the brightness of the nucleus, but at 9h. 0m. 40·5s. (M.E.T.) it was again seen amongst the matter streaming out from the nucleus. It then appeared as an absolutely sharp, bluish point of light, and suffered no apparent alteration beyond a slight twinkling. Herr Osthoff records some cloud observations made at Cologne on May 19, but found nothing which might be ascribed to the action of the comet's tail; the 22° halo around the sun is accepted as the natural result of the presence of the cirrus clouds observed.

Observations made at Warsaw on May 26 indicated that the axis of the tail, in the plane of the comet's orbit, made an angle of 11° with the radius vector at distance 0·18 from the head. Computations by Dr. Banschiewicz show that this would mean a delay of 0·6–0·7d. in the passage of the earth through the tail after the conjunction of the comet with the sun.

No. 23 of the *Comptes rendus*, for June 6, contains several further reports of observations of the comet.

MM. Luizet and Guillaume (p. 1492) give a *résumé* of their observations since early in December, 1909, directing special attention to the changes which took place in the form of the nucleus, the structure of the various parts of the head, and the extent of the tail after the beginning of March. On May 15 it was noted that the pronounced flattening of the nucleus was in a direction perpendicular to that observed on May 14.

MM. Cirera and Ubach give the results obtained at the Observatoire de l'Èbre (Spain), during the period May 11–26, from observations of terrestrial, atmospheric, magnetic, and electrical phenomena. Some disturbances were recorded on May 18 and 19, but the authors believe that they were not connected in any way with the comet, although they hesitate to pronounce definitely on the subject until the results have been more fully considered.

M. Comas Sola, of the Fabra Observatory, describes (p. 1496) a very brilliant projection of gas from the nucleus on May 31. A photograph, exposed for eighty-three minutes, showed that this projection extended some million kilometres from the nucleus, in the direction opposed to that of the sun. A condensation in this projection gave the appearance of a second nucleus, which, on June 2, was about 40″ from the primary nucleus, and was some three magnitudes fainter. Between these two nuclei there appeared to be an alignment of very feeble stellar points, but these were so faint as to be doubtfully seen. A photograph taken, with ninety minutes' exposure, on this date showed, among other interesting details, a long aigrette emerging from the nucleus and forming a medial line in the tail. On June 4 the secondary nucleus was invisible, but the primary was accompanied by four condensations, which travelled rapidly away from it. In 110 minutes the principal one of these was displaced 5·9″, in regard to the primary, in the direction of the tail.

M. Giacobini also directs attention (p. 1496) to the breaking up of the nucleus on June 2. To him it appeared that the comet had split into two nebulosities, each having a nucleus, the only difference between their aspects being that one was considerably fainter than the other. He also remarks on the rapid alteration of the form of the nucleus since May 24. Prior to that date it had been distinctly nebulous and elliptical, but since then it has appeared as a sharply defined point.

As mentioned previously in Nature, M. Jean Mascart travelled to Teneriffe to observe the comet, and set up his instruments on the spot occupied by Piazzi Smith in 1858. He now describes (p. 1497) the instruments and the observing conditions during his two months' sojourn at the station. At an altitude of 2715 metres he was well above

the usual clouds, and only on one night was the sky obscured. Further, he gives a detailed account of his observations of the sky on the night of May 18–19, but beyond an exceptionally fine display of the zodiacal light no special phenomena were remarked.

Photographs of the comet taken at Helwân, Kodaikanal, Johannesburg, &c., were shown at the meeting of the Royal Astronomical Society on Friday last, and all of them show plainly what a striking object the comet was in more favourable latitudes and in clearer skies. The long straight tail is seen to have a very complicated structure of fine filaments and waves.

Several observers have forwarded to us accounts of recent observations of the comet. Mr. Leach, of Malta University, states, on June 8, that the comet had been seen every evening since May 20, and, although fainter, the tail still extended some 20° or 30°. It was best seen on June 1, when the tail extended nearly to Jupiter. He also remarks on the change in the appearance of the nucleus, which, latterly, was quite stellar in character and of about the second magnitude.

Mr. J. W. Scholes, of Grimscar, Huddersfield, sends an account of observations made at Morecambe Bay. A sketch, made at 11.10 p.m. on May 31, in a clear, cloudless sky, shows three plumes, or tails, two shorter ones lying beneath, and separate from, the main tail. The lowest, and shortest, is quite near to Castor and Pollux, and nearly parallel to a line joining them. No simple, definite explanation of this apparition is yet forthcoming.

PAPERS ON INVERTEBRATES.

IN the May number of the *Entomologist's Monthly Magazine*, Dr. D. Sharp records the history of the discovery in the New Forest of a new species of arboreal beetle of the genus Corticaria. One species of this genus, *C. similata*, was for thirty-seven years known as British only by a single specimen. In 1908 beetles of this genus were taken on an oak-tree in the New Forest and identified with that species, which they seemed to indicate to be sexually dimorphic. Other specimens procured, both in the Forest and at Woking, demonstrated, however, that not only was *C. similata* re-discovered in Britain, but that the former area is the home of a new species, for which the name *C. lambiana* is proposed. *C. similata* has been subsequently taken in Scotland.

To the Proceedings of the Academy of Philadelphia for December, 1909, Mr. T. H. Montgomery contributes the second part of his observations on the habits of spiders. Particular interest attaches to his account of the breeding habits of Pisaurina, the species of which closely resemble the Lycosidæ in structure, but differ by being arboreal instead of terrestrial during the cocooning season, and in carrying the cocoons by means of the chelicera instead of suspended from the spinnerets. The large white cocoons of one species are usually found on poison-ivy (*Rhus toxicodendron*); and from observations on specimens kept in confinement it appears that the female carries the cocoon about with her until a few days before the young are ready to hatch. As they emerge, she commences to enclose them with a network of lines, she herself remaining on the outside of the nest thus formed. In this manner the old cocoon and the young spiders are eventually enclosed in a complete nest, which may take as much as three days to construct.

The January and February issues of the same serial for the current year are occupied by papers on molluscs—for the most part American land and fresh-water forms—among which the longest is one by Messrs. Pilsbry and Ferriss, on the land-snails of the south-western States. As the result of their study of Arizona snails, the authors have been led to doubt the power of environment as a main factor in the differentiation of species, and to regard this as capable of explanation only on the hypothesis of variations in the egg, leading to modifications of the organism, for the most part not affecting the well-being of the race. Such adaptation as exists is probably due to selection, and the isolation of colonies would favour the perpetuation of mutations.

Fresh-water gastropods of the genera Limnea and Physa progress, it is well known, by crawling, back-downwards, on the surface-film of the water. On p. 42 of the serial just cited Mr. H. S. Cotton shows that the same mode of progression occurs in the case of a marine bivalve of the genus Modiolaria, the remarkable feature in this instance being the small size of the area of adherence.

To the May number of the *American Naturalist* Dr. H. A. Pilsbry communicates a note on a new type of barnacle (*Stomatolepas praegustator*) inhabiting the mucous membrane of the throat of the loggerhead turtle. Although sessile barnacles are well known to infest the external surface of turtles and whales, while certain parasitic forms penetrate the integument of their crustacean hosts, no commensural thoracic type appears to have been previously described. Stomatolepas belongs to the subfamily Coronulinæ, and is nearly related to Tubicinella, which lives on the skin of whales, and Stephanolepas, a barnacle found imbedded in the horny plates of the shell of the hawksbill turtle.

SOME BIOLOGICAL SERIALS.

THE frequency with which the successive numbers of the *Quarterly Journal of Microscopical Science* make their appearance may be taken as an index of the activity in research—of a particular kind—on the part of British biologists, and the editor is to be congratulated on the issue of seven parts of what used to be literally a quarterly journal during the last twelve months. The April number (vol. lv., part i.) maintains the usual high standard of this publication. It opens with a detailed description, by Prof. G. C. Bourne, of the anatomy of a remarkable New Zealand mollusc, *Incisura* (*Scissurella*) *lytteltonensis*, illustrated by five carefully drawn plates. Mr. W. J. Dakin gives a very full description and discussion of the eye of the scallop—Pecten—an organ which, on account of a certain resemblance to the vertebrate type of eye, has for a long time past attracted a large share of attention from biologists, and which lately, we believe, has played a not unimportant part in the theories of philosophers. Mr. Dakin concludes that "there is no ground whatever for placing the Pecten eye in the same class as the vertebrate eye, for the resemblance is very superficial, and though the retina is inverted in both cases, this has been produced in very different ways." Prof. E. A. Minchin and Dr. H. M. Woodcock have a paper on the blood-parasites of certain fishes, accompanied by three of those remarkably beautiful plates which we have learnt to expect from protozoologists. A special welcome should be extended to another protozoological paper, the first, we believe, from the pen of Mr. Julian S. Huxley, grandson of Prof. T. H. Huxley, which deals in a very thorough manner with a new genus and species of gregarine from the digestive tract of that remarkable crustacean *Anaspides tasmaniae*. Both this memoir and that by Prof. Bourne, already referred to, are based on material obtained by Mr. Geoffrey Smith on his recent trip to Australasia. The number concludes with a reprint of Prof. Hubrecht's address to the Boston meeting of the International Zoological Congress on the fœtal membranes of the vertebrates, in which the author elaborates his remarkable views on the interpretation of mammalian development.

In the second volume of the *Zeitschrift für induktive Abstammungs- und Vererbungslehre* Prof. G. Steinmann further elaborates his theory of the extreme polygenetic origin of the Mammalia. This is a new and somewhat startling hypothesis which does not seem, as yet, to have attracted much attention in this country; its acceptance would involve a far-reaching modification of generally adopted views as to the phylogeny of the Vertebrata. The reptiles, which are themselves supposed by Prof. Steinmann to have arisen polyphyletically from the Amphibia, are divided into two groups, the Orthoreptilia, which include the existing crocodiles, chelonians, lizards, and snakes, and the Metareptilia, which include extinct forms which have no reptilian representatives at the present day. The Metareptilia are again divided into Avireptilia, which are supposed to be the ancestors of the birds, and Mammoreptilia, from different groups of which the various lines of mammalian descent are traced. Thus the Ichthyosauria are regarded as the ancestors of the Delphinoidea, the Plesiosauria of the Physeteroidea, the Thalattosauria of the Mystacocœti, the Pterosauria of the Chiroptera, the

Theriodontia of the Carnivora, and so on. The author bases his theory mainly upon palæontological evidence, but the ordinary zoologist will find it difficult to believe that such highly specialised mammalian features as the development of hair, the allantoic placenta, and the habit of suckling the young have been evolved many times over, and yet always in conjunction with one another.

The third part of the second volume of Dr. J. W. Spengel's "Ergebnisse und Fortschritte der Zoologie" contains two useful summaries. The first, by Mr. H. F. Nierstrasz, deals with recent additions to our knowledge of the Chitons, which has enormously increased during recent years. The second, on the physiology of the facetted eye, by Mr. Reinhard Demoll, is based almost entirely on Exner's classical, but no longer very recent, work on the compound eyes of crustaceans and insects. The problem presented by these eyes is an extremely complex one, and really lies in the domain of the student of physical optics rather than that of the zoologist. On the whole, it appears that the Müllerian theory as to their mode of action still holds the field, but that this theory is not equally applicable to all cases.

REPORTS ON ICE IN SEAS AND OCEANS.

THE report on the state of the ice in the Arctic seas during 1909, published by the Danish Meteorological Institute, possesses more than usual interest on account of Admiral Peary's remarkable sledge journeys in the spring of that year. It summarises the conditions for each month, so far as known from reports supplied by traders to those parts, with maps for April–August inclusive. The state of the ice was unfavourable in Barents Sea and round Spitsbergen, while in the Greenland Sea and Denmark Strait the ice boundary was much more westerly than usual. The coasts of Iceland were almost free of ice, but much was observed off Newfoundland and on the Transatlantic steamer routes. On the south-east of Greenland and in the North American archipelago conditions were very favourable; in the Bering Sea they were about normal, and in the Beaufort Sea rather favourable, especially towards the middle of the summer. It is inferred that the amount of ice along the south-east of Greenland will be somewhat small in 1910, and that favourable conditions along the south-west coast of Greenland may result during the summer of this year.

From statements made on the useful monthly meteorological charts for the North Atlantic and Indian Oceans for April last, issued by authority of the Meteorological Committee, it appears that ice was scarce in the Southern Ocean during 1909. Up to about the middle of March last reports of only forty bergs passed in that year were received by the Meteorological Office; half these related to a position midway between New Zealand and Cape Horn. A later chart, however, states that from December, 1909, they commenced to be rather frequently reported. Tables referring to the bergs met with in previous years show that lengths of six to thirty miles are not uncommon, while some thirty of those sighted in that ocean in the last quarter of a century were 800 feet or above in height. Up to the present time, the report states, the birthplace of the largest of the bergs (1000 to 1500 feet in height) has not been definitely settled.

THE INTERNATIONAL HORTICULTURAL CONGRESS.

THE International Horticultural Congress at Brussels, April 30 to May 3, was attended by a large number of representatives, including delegates from the important horticultural societies. The meetings took place in the Salle des Fêtes in the grounds of the Great Exposition, at that time in a very incomplete state. Among the various subjects discussed was that of horticultural nomenclature. While there has been a general desire on the part of the more scientific horticulturists to conform to the rules of botanical nomenclature agreed upon at the International Botanical Congress at Vienna in 1905, it was felt that certain details which were not discussed at Vienna, but which were of special interest to horticulturists, should be definitely settled. The congress was unanimous in agreeing to adopt the Vienna rules of nomenclature, with necessary additions in the case of horticultural varieties and hybrids. It was agreed that the names of horticultural varieties, expressed, in accordance with the rules, in the vulgar tongue, must remain fixed when used in other languages than the one in which they were originally employed. When possible, the name should consist of a single word, and never of more than two, or at most three, words. To ensure valid publication a description of the variety must be drawn up in Latin, English, French, German, or Italian.

As regards garden hybrids, it was agreed that the specific name may be expressed in Latin, or in a vulgar tongue and written in Roman characters; if possible it should be a single word, but, at any rate, not more than three words. Various suggestions had been made as to the system of nomenclature for artificial hybrids in which two, three, or more genera are involved. In the case of bigeneric hybrids, the general custom was confirmed of forming a Latin generic name by the combination of the names of the parents; the specific name, also in Latin form, is to be separated from the generic by the sign of hybridity, thus, *Laeliocattleya* × *Smithii*. For plurigeneric hybrids the recommendation of the Royal Horticultural Society of London was adopted, namely, the use of a conventional generic name, derived from that of some person of distinction, with the termination *ara*, *e.g.* Lawrenceara.

The programme of the congress also included a visit to the Royal park and conservatories at Laeken, and to the new colonial gardens and plant-houses. The latter contain many plants of interest from the Congo.

LOWELL OBSERVATORY PHOTOGRAPHS OF THE PLANETS.[1]

THE pictures which I have the honour of showing tonight represent the results of the new planetary photography originated at Flagstaff in 1903–5, and now beginning to be successfully copied elsewhere, notably this last summer by M. le Comte de la Baume Pluvinel and M. Baldet in France, who from the summit of the Pic du Midi de Bigorre succeeded themselves in getting imprints of the canals of Mars. Although the method was originally designed to exhibit the markings of what is practically our nearest neighbour in space, it has since been applied to the other planets with an outcome as surprising as it is satisfactory. Little details which one would not have supposed could sit still long enough for their pictures to be taken stand out unmistakably on the plates, the faint equatorial wisps of Jupiter offering a good example of such tractability, though by no means the most remarkable.

That the canals of Mars should be made to write their own signatures on a photographic plate was the occasion of the invention of the process, which, after long and patient study by my assistant, Mr. Lampland, they were finally induced to do. To his marvellous feat the best tribute was that of Schiaparelli, who, after recognising the canals on the print sent him, wrote me in wonder that photography could be made to do such work, "I would never have believed it possible." Since then further improvement has been reached, to which almost every member of the staff has contributed. The process is based upon what our visual study of the planets has taught us to be the crux in the matter—the all-importance of definition. For this reason the older celestial photography, which furnishes such beautiful pictures of the stars and nebulæ, was here impotent. This will be realised when one considers that the whole disc of a planet could be put inside the image of a single star. For a like cause reflectors cannot be employed, for with them all faults, instrumental or atmospheric, are magnified three-fold over those of a lens. They may give imposing-looking pictures, but the finer detail is lost, a fact which is evident at once to an expert. Now it is in the registration of this finer detail that the accomplishment lies, and which from a scientific point of view marks its importance.

Study of the conditions leading to definition has made these photographs possible, just as lack of such study alone makes possible the scepticism one sometimes hears.

[1] A discourse delivered at the Royal Institution on April 8 by Prof. Percival Lowell.

Thus it is a well-known fact with us that the main markings of a disc may come out sharp, while the delicate ones are obliterated by a blur which otherwise eludes detection. This applies as much to photographic as to visual results, and it is this defect that a reflector introduces. Another optical mistake, which has latterly been hailed as showing that the lines are not lines, but a series of dots, was made the other day in France. The observer saw perfectly correctly, but one with knowledge of the optics of a telescope in our air should have known that the effect observed was the inevitable result of using an aperture which the seeing did not warrant, as he could easily have assured himself by looking at the shattered rings in the synchronous image of a star. Even in our far better Flagstaff atmosphere the best results are got by diaphragming the aperture down.

In photography we cannot diaphragm down to advantage because we need the light, and this is one reason why photographs cannot rival an expert eye. Visual observations conducted by an eye fitted by nature, and trained by experience, must always surpass the best the camera can do.

One reason for this resides in the fact that the eye registers its impression in the twentieth of a second, while the plate takes forty times as long. The result is that the planet's presentments in its bad moments are superposed upon its good ones to a composite photograph of the whole, not unlike that got from a similarly merged company of doctors where all individuality is lost in one inane smile. As such well-meaning imbecility does not do justice to the planet, its exposure-time must be shortened to the limit of effect.

For a like reason the out-of-focus images of what by courtesy is called the achromatic telescope must be suppressed. So what the new process does is to monochromatise the light as nearly as possible. This is accomplished by a colour-screen, and a plate sensitised in accord with it. Then at the moment of exposure every precaution is taken that all movement shall be as nearly nil as can be secured within the instrument itself, and in the air without it. Lastly, he who would photograph the canals most successfully must first have seen them, that he may know when his opportunity arrives.

Planetary photography is not intended, nor is it destined, to supersede visual observation. Research on the planets must rest in future, as in the past, on the ultimate power of the eye and of the brain behind it, a useful adjunct in such investigation, whether this take the form of telescopic, spectroscopic, or other perhaps new line of inquiry. But in certain ways the sensitive plate may supplement the retina. Position is one of these, contrast another. For the eye to place in their proper posts all the markings of a multi-featured disc in the short time at its disposal is a well-nigh impossible task. The film registers them at once *in situ*. Values are another thing the photographs bring out clearly. They exaggerate contrast, it is true, as compared with the eye; but this is no detriment. Rather the reverse, for it furnishes a greater scale for measurement.

In looking at the photographs two things must be borne in mind. One is that the irregularities due to the grain of the plate must not be attributed to the images. Thus, within the limits set by the grain, the lines on Mars show as lines, not as a patchwork. This is perfectly apparent when they are carefully scanned. When we consider that the original images are only 5 mm. in diameter we realise the strain of lantern exhibition. Even so they are magnified 200 times in the taking. They are then further enlarged on the slide, and lastly thrown greatly increased upon the screen. The wonder is that they stand this limelight publicity at all.

The second point is that we are not dependent on them for our minute knowledge of the planet. A good eye trained to the subject sees at least ten times as delicately as the film; but it must be an eye suited to planetary work, which is quite a different eye from that good at faint satellite or nebula detection. It is very important to remember this, for not only is there a physiologic reason for it, but mistake of it is often made in high quarters. When an observer records a polar flattening as twice and four times what hydrodynamics permit, his forte lies elsewhere than in planetary research.

Three planets will now show you their presentments, Mars, Jupiter, and Saturn. I was minded at first to omit Mars, passing by this old acquaintance with a nod, but so great have I found the interest in him here as elsewhere that he has been put beside the others.

As an example of the delicacy of the detail to be described on him, not only by the eye, but in the photographs, may be instanced the sight of one of the many vicissitudes of his changeful year, which suddenly appeared one day when least expected. The event was the first frost of the season in the Antarctic regions of Mars, detected visually at Flagstaff on November 16. The patch was at once photographed, and is plainly apparent on the plate. To chronicle thus the very weather on our neighbour will convince anyone that interplanetary communication has already begun, and that, too, after the usual conventional manner of ordinary mundane greetings.

My next mention shall show you the pitch of precision to which measurements of these little prints can attain. It is well known that the south polar cap of Mars is not centred on the pole, but lies some 6° off it, in longitude 20° or thereabouts. When the images showing the cap at two different longitudes were measured, the measures revealed distinctly the excentring of the cap, and even registered with some accuracy its amount and position. When we reflect what this means, it looks as if Mr. Crommelin's belief that areology would stand indebted to the photographs for help in its geodetic survey is in a fair way to be realised.

It would be possible in these photographs to take you on many a journey to that other world, but one such interplanetary voyage must suffice. This shall give you sight of the great new canals that appeared last September in a region of the planet where no canals had ever showed before. To begin with, you should know that the lines you will see are certainties, not matters admitting of the slightest question for all their strange regularity, and so seen by all those who, from the most prolonged and careful study, are qualified to speak. Schiaparelli described them as looking as if they had been laid down with rule and compass, and not only I, but all of my assistants, have seen them thousands of times the same. Nor are they near the limit of vision in our air, which sometimes sets the planet against the sky as if etched in a steel engraving.

In the second place, the technical word "canals" does not mean ditches dug, but artificially fertilised strips of country to which the water from the polar cap is led by some mechanical means. We have proof of their artificiality from the fact that they develop latitudinally down the disc from pole to equator after the cap begins to melt, for on a body the surface of which is in equilibrium, as with Mars, neither water nor any other substance could take this equatorward course unless it were intelligently conducted. What the conduits that lead it may be like we ignore, for all we see is their effect on vegetation.

Lastly, the organisms of Mars can hardly resemble men, which opens up for them unknown possibilities of intelligence and renders them really interesting.

On September 30 last, when the region to the east of the Syrtis Major came round into view again after its periodic hiding of six weeks, due to the unequal days of the earth and Mars, two imposing canals were seen leading up from the Syrtis to the south-east, which had not been there at the preceding presentation. Research showed that not only had they never previously been seen, but that they could never have existed as such before. The long and full records of the observatory, extending over fifteen years, made it possible to be absolutely sure of this. Yet these canals, with several subsidiary ones, fitted into the general canal system as if they had always made part of it.

Not only was their coming into existence established by the drawings, but the photographs of previous years testified to the same unheralded advent. By comparing the drawings and photographs made at the same epoch the oneness of the two becomes evident, while the change of both with the Martian seasons is clearly portrayed. Thus we have actually witnessed a "canal" called into being by the life existent at this moment on the surface of Mars.

Turning now to Jupiter, we find a completely different

set of features registered on the plates, no less corroborative of the drawings made of him at Flagstaff, but utterly unlike those of Mars. Their symmetry is immediately striking, and then no less is its purely latitudinal character. They are belts, bright and dark, banding the disc half-way to the poles. Their behaviour, however, indicates in them no regard for the sun, as they are quite oblivious both to the planet's day and to his year. They last indifferently through both, and disappear at their own good time. That the brighter are clouds and the darker the gaps between seems inferable; but they are not as our clouds. With us the heat that causes cloud comes from without, with Jupiter from within. Sun-occasioned the one, self-evolved the other. We have visual evidence of this internal heat of Jupiter in the cherry-red that tinges his darker belts, as if we there looked down into the seething cauldron below. We have theoretic proof of it, too, in the oblateness the disc presents taken in connection with what we know to be the planet's mean density. In two articles shortly to appear in the *Philosophical Magazine*, those who care for mathematics will find that his own fire alone enables Jupiter to keep his youthful figure, and, furthermore, that his shape shows him to consist of a comparatively small kernel wrapped in a huge husk of cloud. Even those who do not care for the oldest of the sciences must admit a certain grandeur in it when theory can thus plumb depths experiment may never fathom.

These belts have another peculiarity. Their several parts are travelling at idiosyncratic rates. With them it is a go-as-you-please race, in which each outruns or falls behind its neighbour. On this interesting subject we owe most to your fellow countryman, Mr. Stanley Williams, who for some years has acted as timekeeper and referee of this Jovian family contest. In future he will have no mean rival in the photographic plate. Not that it sees as well, but that it may be measured at leisure by any investigator who likes.

There is one feature in the photographs which has had a long and eventful history. I refer to the Great Red Spot. Detected in 1879, it lasted as such to within a few years. Rather a long life for a hole in the clouds! Now, properly speaking, we see only the grave in which it lies buried, the oval shell it once occupied; but these same photographs were, in a sense, the means of bringing its cradle also to light. Sixty years ago, a cycle of Cathay, Sir Wiliam Huggins made a fine series of drawings of the planet, and on receiving the present pictures was struck by the resemblance of the two. In consequence he sent me prints of his. On scanning them my eye was caught by an oval placed as the present one lies. Clearly it was the cradle prepared already for the Great Red Spot twenty years in advance. He had been present before its birth, as he is still, happily, present after its demise.

In the next set of images we envisage a Jovian event of some interest, in spite of the frequency with which it occurs—the transit both of a satellite and of its shadow across the planet's disc. For this means to Jupiter the occasion of a total eclipse of the sun, an impressive phenomenon were there anyone there to see. In the left-hand images the satellite itself may be descried just passing off the disc, while in their complete procession the shadow, which is the eclipse, may successively be followed in its travels from one side toward the other of the planet's face. The swiftness of its traverse may be marked in the displacement it undergoes, not only directly, but with regard to the Jovian cloud-belts, which are themselves whirling round at the rate of 25,000 miles an hour. To witness thus the progress of a total solar eclipse on the great planet gives one, perhaps, his most vivid experience of Jovian affairs.

The third point we may mention in these photographs is their revelation of the equatorial wisps. Some years ago Mr. Scriven Bolton detected a most curious set of markings lacing Jupiter's bright equatorial belt. His discovery met with the usual approved disapprobation which has been the orthodox reception of astronomical advance since Galileo's time. Were a discovery to be hospitably hailed it would prove disconcerting to the discoverer, who would instantly suspect something wrong. Eventually the subject was referred to us for corroboration. This we were able, fortunately, to secure. A singular phenomenon they proved to be, criss-cross filaments of shading traversing the belt from triangular spots at its edges, for all the world like the lacings of a sail that hold the bolt-rope to its spar. Though perfectly evident to the eye, we hardly hoped to catch them on a plate. Nevertheless, Mr. E. C. Slipher did, and innumerable other images of them have since been got by us; their pictures you will presently see for yourselves upon the screen. Why such peculiar rents should be torn in the planet's great cloud envelope we cannot yet explain, but further news about them has still more lately come to us from the planet to which we now pass in our journey outward from the sun, the great ringed planet Saturn.

In some respects Saturn is the most difficult of the three planets to photograph, certainly the most tiring. So faintly is it illuminated that what takes but two seconds for Mars takes twenty or more for Saturn. To keep the image of the planet upon its guiding cross-wires for that length of time, with the nervous knowledge that any slip will be

Reproduction of a photograph of the planet Saturn taken on November 4, 1909, by Prof. Lowell.

fatal, seems an eternity. Since sensations measure existence, it may be commended as a sure, though not happy, way to prolong one's life.

On the resultant images may be seen abundant detail. Cassini's division is there as large as life, and somewhat broader, due to the difficulty of keeping it still; so also is the shading of the inner side of ring B, and the tones of the several portions of ring A. The ball appears finely, its belts standing out even more than to the eye, and the duskiness of its polar hoods being peculiarly pronounced. The shadow of the ball upon the rings is, of course, salient, and so is the shadow of the rings upon the ball. This much is evident at a glance, but there is more to be made out by him who examines closely.

If we consider the images of November 4, which happen to be mine, we shall notice a dark band below the rings where they cross the ball, and one which is but dusky above them. Now at this date both the sun and the earth were above the plane of the rings, as we see the image, the sun the higher, the sun's relative latitude being $-12° \ 18'$, that of earth $-11° \ 4'$.

We saw, in consequence, the shadow of the rings A and B underneath the rings themselves. This accounts for the dark band below. What, then, was the dusky band above? It could not be the shadow of these rings, for the shadow could not fall on both sides of them at once, nor could it be seen above. A little consideration will reveal to us what this band was. Inside of ring B toward the planet lies the crêpe-ring C. It is a semi-transparent ring, because its particles are widely scattered, instead of seeming solid like the outer rings, where the particles lie closer together. Their constitution we owe to perhaps the greatest mind of the last century, your own Clerk-Maxwell. This, then, was the explanation: in the dusky band we were looking through the crêpe-ring on to its own shadow thrown upon the ball. Thus the crêpe-ring revealed its presence unmistakably, not by being seen, but by being seen through.

When we compare these images of November 4 with those taken by Mr. E. C. Slipher on September 9, we note

a marked contrast in the two fringes of shadow. This corroborates what we have just deduced, for at this time the relative positions of the sun and earth were reversed.

In the case of Saturn we have, as another interesting detail, the excellent instance it affords of contrast. From the bright equatorial belt, the most brilliant part of the whole picture, we notice a regular gradation of tints down to the faintest parts of the rings, for it is noteworthy that the dark belts of the planet are not so dark as these. This grading is particularly serviceable for being practically that of the eye, for the colour screen and plate used were such as to give us the light from that portion of the spectrum of which the eye takes greatest cognisance. The relative effect, therefore, on the plate is the same as on the retina.

Lastly, we come to what is one of the greatest triumphs of the whole process, the self-recording of the wisps of Saturn. It was in September that these wisps were first detected visually, independently, by my assistant, Mr. E. C. Slipher, and myself. Curiously enough, they were suspected synchronously on the photographic images, and on later ones were definitely seen. They counterpart almost precisely those of Jupiter, though, of course, in very faint replica. Here comes in the beauty of the photographic method. Instead of taking but a single image, twenty or more are taken one after the other on a single plate. Meanwhile, the colour-screen is moved. Thus any detail in the image due to defect on the plate proclaims its origin by its singularity, and in the same manner the colour-screen betrays its self-written markings. If a detail is repeated on several images in place it must be real, however faint.

As we take our leave of Saturn let me point out the beautiful elliptical figures of the rings thus shown, a symmetrical correctness wonderfully pleasing to the eye, and which the best of drawings fails to reproduce.

From the detail these photographs have thus proved themselves able to depict, they mark a new departure in planetary research. While, on the one hand, they exhibit to the world at large something of the advance recently achieved in our knowledge of the solar system, on the other they constitute in themselves the beginning of a set of records in which the future of the planets may be confronted with its archived past, and which shall endure after those who first conceived such registry shall have long since passed away. They can never take the place of first-rate visual observation, but they will form a firm foundation for whatever shall subsequently be seen, and will enable such changes as must inevitably ensue to be the better collated and compared. They are the histories of the planets written by themselves, their autobiographies penned by light; and in their grand historical portrait gallery, where the planets' pasts live on for ever in immortal youth, astronomers yet to come may see the earlier stages of the great cosmic drama which is slowly but surely working itself out.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Mr. E. M. Holmes, whose magnificent collection of seaweeds and algæ was purchased for the University some time ago, has now presented to the botanical department another series of about 2000 beautifully preserved specimens, together with a number of valuable books on algology. The possession of this collection, the finest of the kind in the world, places the University in a unique position for the study of this branch of botany.

Prof. Sidney S. Dawson has resigned the chair of accounting.

An official degree of M.Sc. is to be conferred on Prof. F. W. Gamble.

Dr. Arthur Francis Bashford, director of the Imperial Cancer Research, has been appointed to deliver the Ingleby lectures for 1911.

Prof. Charles Lapworth, F.R.S., has been appointed to represent the University at the International Geological Congress at Stockholm in August next.

CAMBRIDGE.—The general board of studies has appointed the following university lecturers:—Dr. Marr, geology; Dr. Shore, physiology; Dr. Baker and Mr. J. H. Grace, mathematics; Mr. G. F. C. Searle and Mr. C. T. R. Wilson, experimental physics; and Mr. H. O. Meredith, economics.

The special board for biology and geology has nominated Prof. I. Ikeda to occupy the university table at the laboratory of the Marine Biological Association at Plymouth for three weeks between July 15 and August 30.

GLASGOW.—Among the recipients of the honorary degree of Doctor of Laws on Thursday, June 9, were Dr. H. Dyer, C.E., first principal of the Imperial College of Engineering, Tokyo, now honorary principal of the college, and emeritus professor of the University of Tokyo; and Prof. G. O. A. Montelius, royal antiquary of Sweden and professor at the National Archæological Museum, Stockholm.

LEEDS.—On Saturday, June 11, the University held a Congregation for the purpose of installing the Duke of Devonshire as Chancellor in succession to the late Marquis of Ripon. The gathering, which included the Mayor and Corporation of the City, a large representation of Yorkshire civic and educational authorities, as well as the Court, Senate, and Convocation of the University, was held in the Town Hall. After the ceremony of installation a band of one hundred and fifty students sang a chorus from Bach's "Dramma per Musica." The Chancellor delivered a short address, in which he alluded to the hereditary interest of his family in the fortunes of the Yorkshire College and the Leeds University, and expressed himself anxious to maintain the tradition to the utmost of his power. He commended the work of tutorial university extension and the prosecution of research, especially in connection with the prevention of disease. In connection with the ceremony, honorary degrees were conferred on a number of distinguished public men, including the Prime Minister (who was born near Leeds), the Earl of Crewe, Lord Lansdowne, and the Speaker. The degree of D.Sc. was conferred on Lord Rayleigh, Sir Clements Markham, K.C.B., and Prof. Osler. Sir Hugh Bell, Bart., received the degree of LL.D. On behalf of the honorary graduates, Mr. Asquith congratulated the University upon the installation of its new Chancellor. He expressed the opinion that the new universities had justified the faith and fulfilled the high hopes of their founders, and he passed a warm eulogium upon the work of the University of Leeds. The ceremonial of the proceedings, which was picturesque without being archaic, excited great interest, and the part taken by the students met with general approbation.

ON Thursday, June 23, Dr. H. A. Miers, F.R.S., principal of the University of London, will present the prizes at the London (Royal Free Hospital) School of Medicine for Women. Mrs. Garrett-Anderson, president of the school, will occupy the chair.

WE learn from *Science* that an announcement has been made of the receipt by Western Reserve University of a gift of 50,000*l*. by Mr. H. M. Hanna, as an addition to the endowment of the medical department, and that Mr. J. Ogden Armour has made a gift of 14,000*l*. to the Armour Institute of Technology.

ACCORDING to a Reuter message from Peking, the Throne of China, approving a recommendation of its Board of Education, decrees that English shall be the official language for scientific and technical education. The study of English is made compulsory in all provincial scientific and technical high schools.

THE annual conference of the Association of Teachers in Technical Institutions, which was postponed on account of the death of King Edward VII., will be held at Birmingham on Friday and Saturday, June 17 and 18. Mr. J. Wilson, president of the association, will deliver his address on the latter day, and a paper will be read by Dr. T. Slater Price on the relations of technical institutions to the universities.

THE late Prof. J. Campbell Brown, professor of chemistry for thirty-two years in Liverpool University, left estate of the gross value of 43,101*l*., of which the net personalty has been sworn at 42,740*l*. We learn from the *Times* that he bequeathed to the professors of chemistry of the University

of Liverpool and their successors his collection of old alchemical and similar books, to be kept together as the nucleus of a collection for the professors' private room. He left a sum sufficient to produce an annual income of 50*l.* to Liverpool University to found an advanced chemical scholarship to be called "The Campbell Brown Scholarship," and a sum sufficient to produce an annual income of 800*l.* to the University of Liverpool upon trust for the endowment of a chair of chemistry in addition to existing chairs, to be called the Campbell Brown chair, or if a chair shall have been endowed, then either for a chair for the teaching of agricultural chemistry or a chair of some other branch of industrial chemistry. He also left 5000*l.* to the University upon trust to place the income at the disposal of the Campbell Brown professor for the time being towards the cost of his apparatus and material. If the University of Liverpool shall not accept the bequest for the endowment of the chair on these conditions, the whole sums are to be given to the University of Manchester to endow a Campbell Brown chair of music. The residue of his property he left upon trust to found a series of entrance scholarships each of the value of 60*l.* per annum, to be held at the University of Liverpool, tenable for three years and renewable for a fourth. The value of the bequest for the proposed professorship is from 25,000*l.* to 28,000*l.*, of that for the advanced chemical scholarship 1500*l.*, and for the entrance scholarships 5000*l.* to 8000*l.*

AT one of the meetings of the Women's Congress held at the Japan-British Exhibition on June 8, the question of a university standard in home science was discussed. Mrs. St. Loe Strachey read a paper on the ideals of home science, and defined a university standard as meaning the attainment by a student of such a standard of knowledge as could be rewarded by the grant of a degree if it had been attained in a subject in which our universities examine for a degree. In the special courses in home science being held at King's College for Women, the teaching claims to attain to a university standard. The students are not allowed to be content with merely acquiring a knowledge of the technical processes carried on in the practice of domestic science, but are required to study at first hand the various scientific principles which underlie the proper conduct of a house or institution and the bringing up of the young. It is true, she said, that women in our universities have for many years past studied physics, chemistry, biology, bacteriology, and, indeed, the whole list of sciences mentioned in the King's College syllabus, but the point is that these subjects should be studied in a definite, coordinated course, having for its object "to provide a scientific education in the principles which underlie the whole organisation of home life." Miss Oakeley, warden of King's College Women's Department, said the new movement met the spirit of the age in its insistence that science should be everywhere, that reason should occupy all spheres, that there should be no dark corners left. The meeting seemed hardly to realise that to be thoroughly effective in improving the conditions of home-life the science teaching received by women must be begun in the school, and that many women will have few opportunities for further study after school days are over. The conditions in the schools must be improved. First, a course of practical work in science suitable for girls, and having the needs of the home before it at every stage, must be forthcoming; and, secondly, there must be a supply of well-educated mistresses who, in addition to their laboratory practice and general knowledge of science, have gained a first-hand acquaintance with household needs and difficulties, and have become experts in such arts as are required in the kitchen and laundry.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 9.—Sir Archibald Geikie, K.C.B., president, in the chair.—J. A. **Gray**: The distribution of velocity in the β rays from a radio-active substance. The β rays from some radio-active substances have been deflected in a magnetic field, and the detection of sets of homogeneous β rays attempted by the photographic method. Radium emanation was the substance first used. It was placed in a very narrow thin-walled tube, drawn out from capillary tubing, so thin that the α rays from the emanation escaped. Enough black paper was placed over the tube to absorb the α rays and to protect the photographic film from phosphorescence caused by the α rays. The β rays from the active deposit had thus to pass through very little absorbing material. If the β rays from a simple radio-active substance are emitted at an identical speed, we should therefore expect to find evidence of such, even if β rays do change slightly in velocity in passing through matter. Although several photographs were taken, no sign was found of sets of homogeneous β rays from Ra*B* and Ra*C*. Experiments were then tried with Ra*E* as radiating substance. Here we have β rays which are very nearly absorbed according to an exponential law, and if, as many writers have assumed, absorption according to an exponential law signifies homogeneous β rays, these rays should be practically homogeneous. It was found, however, that the velocities of the rays were distributed over a wide range. The results of the experiments may be summarised as follows:—(1) β rays which are absorbed according to an exponential law are not homogeneous; (2) β rays must fall in velocity in passing through matter, for, if not, the absorption coefficient of any mixture of rays must decrease as the rays pass through matter.—W. **Wilson**: The decrease of velocity of the β particles on passing through matter. In a previous paper it was shown that the velocity of β particles suffers an appreciable decrease on passing through matter. The present experiments were undertaken with the view of directly confirming this result. Homogeneous beams of rays were separated by means of a magnetic field from a heterogeneous beam given out by the active deposit from radium. These homogeneous rays passed into another magnetic field, where their velocity was measured. Sheets of aluminium were then placed in the path of the rays between the two fields, and the velocity of the emergent rays was found to have decreased by an appreciable amount. From considerations of the law of absorption found to hold for homogeneous rays, the decrease of velocity of the rays as they pass through matter could be calculated, and was found to agree with the results obtained experimentally. The results obtained are in agreement with the equations $E=k(a-x)$ and $E^2=k'(a'-x)$, where E is the energy of the rays, x the thickness of matter traversed, and k and a constants. The agreement is rather better in the former case than in the latter, but the range of velocities considered was not sufficient to differentiate sharply between them. Although the change in velocity observed was only from $2{\cdot}85\times10^{10}$ to $2{\cdot}25\times10^{10}$ cm. per sec., yet the change of the properties of the rays with respect to absorption is very large, the absorption coefficient of the former being 4·9 cm.$^{-1}$, while that of the latter is 35·2 cm.$^{-1}$.—J. N. **Brown**: The rate of emission of α particles from uranium and its products. The object of the experiments was to estimate the number of α particles emitted per second per gram of uranium in equilibrium with all its products (*i.e.* as it occurs in pitchblende). The pitchblende was prepared as a thin film, over which was placed a zinc sulphide screen. The scintillations produced on the screen by the α particles were observed through a microscope. Each scintillation corresponded to the emission of one α particle from the pitchblende. The weight of pitchblende sending particles to the portion of screen viewed by the microscope was readily obtained, and since the screen was very close to the film the number observed could be taken as half the total quantity emitted by this weight of pitchblende so long as the thickness of the film was less than the distance of penetration of α rays into pitchblende. This point was ensured by making observations on films of various thicknesses and plotting a curve between number of scintillations per minute and weight of film, the result being calculated from a film for which the curve showed the rate of production of scintillations to be proportional to the thickness. The percentage of uranium in the pitchblende was estimated, and the result finally expressed as number of α particles per second per gram of uranium in equilibrium with its products, the figure obtained being $7{\cdot}36\times10^4$. From Rutherford's result for radium the value for uranium can be obtained through a series of calculations, each of which may involve a 5 per cent. error. The value obtained in this way is $9{\cdot}1\times10^4$.—Hon. R. J. **Strutt**: The accumulation of helium in geological time, iv

s paper gives further determinations of the ratio of ium to radio-active matter in minerals, chiefly those urring in Archæan rocks. Very large relative quanti- ; of helium are found, in one instance (a sphene from nfrew Co., Ontario) indicating an antiquity of at least million years, even if no helium has escaped. The que case of beryl, which, as shown in a former paper, itains much helium with hardly any radio-active matter, discussed. An explanation, suggested by Dr. Boltwood, put forward. It is supposed that beryl, in crystallising, ; separated from the parent magma one of the longer- ed products of the uranium or thorium series, such, for imple, as radium, ionium, or radio-thorium, without the ent element. This product would decay, leaving no ce of its presence except the helium generated. Reasons given for believing that nothing of this kind has opened in the cases relied on for measuring time.— T. **Lattey**: The effect of small traces of moisture on velocities of ions generated by Röntgen rays in air. me experiments of Prof. J. S. Townsend (Proc. Roy. c., vol. lxxxi., A, 1908, 464) on lateral diffusion of a rrow stream of ions moving in an electric field led to conclusion that negative ions are much smaller in per- tly dry air than in air containing a small quantity of isture. It was consequently to be expected that com- te removal of water vapour would cause an increase in velocity with which negative ions move under the luence of an electric field of force. At his suggestion an estigation of the velocities of ions in air at low pressures s undertaken, and it was found that, while the complete noval of water vapour had only a small effect on the locities of positive ions, yet the same cause increased velocities of negative ions by a factor rising to as ich as thirty for some of the forces that were used, and is factor appeared to be much larger for larger forces. ie velocities of positive ions are known to vary directly th the potential gradient (X) and inversely with the essure (p) of the gas in which they are travelling; in her words, vp/X is a constant where v is the velocity. tween 14 and 29 mm. pressure the following values of X were obtained:—dry air, $vp/X=1121$; moist air, $/X=780$. In the case of negative ions it is known that hen air is moist v is not a linear function of X/p, but at vp/X increases slightly as X/p increases. The locity is, however, a function of X/p, and is independent actual values of either X or p. In dry air it was found at while v is still a function of X/p, yet the rate of crease of v with increase of X/p is considerably more pid than in moist air. This is illustrated by the follow- g table:—

Velocities of Negative Ions in Dry Air in Centimetres per Second.

(mm.)	X/p=0·04	0·05	0·06	0·07	0·08	0·09	0·10
14·3 ...	107	175·5	310	580	1126	2200	4210
18·4 ...	103	163	279	514·5	1006	2050	4120
24·5 ..	110·5	172·5	286	509	936·5	1799	3480
28·8 ...	116	180	208·5	519·5	926	1652	—
Mean ...	112·5	173·2	287·8	510·5	953·5	1845	3635

us when pressure remains constant at 14·3 mm. and rce varies from 0·56 volt per centimetre to 1·43 volts r centimetre, velocity increases from 107 centimetres per cond to about 4000 centimetres per second. When the as is slightly moist the corresponding velocities would be out 32 centimetres per second and 90 centimetres per cond. Thus in air containing about 11·5 per cent. (by ressure) of water vapour the velocities observed were:—

(mm.)	X/p=0·09	0·10
18·0	80	89
19·3	83	92
Mean	81·6	91·7

-Dr. A. O. **Rankine**: The variation with temperature of ie viscosities of the gases of the argon group. The ratio f the viscosity at the temperature of steam to that at tmospheric temperature has been determined for each of ie five gases. Taking Sutherland's equation $\eta=\frac{KT^{\frac{1}{2}}}{1+C/T}$, he values of C have been calculated, and are shown in ie following table. C is least in the case of neon; in act, this is the lowest value yet recorded for any gas. This suggests that neon is the most nearly perfect gas known. A further interesting point is that C is, in the cases of argon, krypton, and xenon, proportional to the critical temperature:—

	He	Ne	A	Kr	X
C	70	56	142	188	252
T_c	—	[63]	155·6	210·5	288
T_c/C ...	—	[1·12]	1·10	1·12	1·14

The critical temperatures of helium and neon are not definitely known, but it is certain that T_c for helium is much too low to conform with the above rule. With regard to neon, however, T_c is known to be less than 68° absolute, and this does not exclude the value 63° absolute calculated by means of this rule. It has also been noticed that, with the exception of hydrogen, the same rule holds good for all other gases the data for which are available. —Dr. W. G. **Duffield**: The effect of pressure upon arc spectra. Part ii. No. 4.—Gold.—Prof. B. **Hopkinson**: Radiation in a gaseous explosion. The pressures produced by the explosion of a mixture of coal-gas and air in a vessel plated with silver on the inside have been recorded, first with the walls highly polished, and second when the walls are blackened. The mixture contained 15 per cent. coal-gas, and was at atmospheric pressure and temperature before firing. The maximum pressure reached in the explosion was about 110 lb. per square inch above atmosphere, corresponding to a temperature of about 2200° C. It was found that when the walls were polished the maximum pressure was about 3 per cent. higher, and the rate of cooling for the first half-second about 35 per cent. less, than when the walls were blackened. The state of polish of the walls had a great effect on the rate of cooling, differences hardly appreciable to the eye making a marked difference in the rate of fall of pressure. The heat received by polished and blackened surfaces, respectively, was determined by means of a bolometer of silver strip fixed to the walls, the remainder of which was black. The change of resistance of this strip during explosion and cooling was recorded by means of a reflecting galvanometer on a moving film simultaneously with the pressure. From the rise of temperature of the strip and its capacity for heat the heat-flow into it could be deduced. It was found that when the strip was polished the heat received during the first quarter of a second after firing was three-fourths of that received by blackened strip in the same period, the pressure records being the same. Relative rates of heat loss to completely blackened and completely polished walls deduced from pressure records, during 0·25 second, varied from 0·6 to 0·7. Direct measurement of radiation from the gas was made by means of a recording bolometer placed outside the vessel, and exposed to the radiation through a fluorite window. At the end of half a second after ignition the total quantity of heat radiated and recorded by the bolometer amounted to 22 per cent. of the heat of combustion of the gas. At this period the gas was still radiating heat to a perceptible amount, its temperature being then 1000° C. At the moment of maximum pressure (1/20 second after ignition) 3 per cent. of the heat of combustion had been radiated away. The radiation recorded by the external bolometer exceeds by about 50 per cent. the difference between the heat absorptions by the blackened and polished silver respectively. The estimate of the latter difference is, however, subject to a good deal of uncertainty on account of the large correction for heat lost to the backing to which the bolometer strip is fixed. Moreover, there are reasons for supposing that it does not represent the whole of the radiated heat.

Royal Microscopical Society, May 25.—Mr. A. N. Disney, vice-president, in the chair.—Dr. M. D. **Ewell**: Comparative micrometric measurements.—E. **Heron-Allen** and A. **Earland**: The recent and fossil Foraminifera of the shore sands of Selsey Bill, Sussex, part v., the Cretaceous Foraminifera.

Physical Society, May 27.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Dr. W. H. **Eccles**: An oscillation detector actuated solely by resistance-temperature variations. Experiments are offered as additional support for the hypothesis of the mode of action of certain types of electrical oscillation detectors. This hypothesis suggests that in detectors constituted of a loose contact, the

energy of the oscillatory current through the contact is transformed into heat at the contact and warms the matter there sufficiently to change its electrical resistance, and, consequently, the steady current through the indicating instrument. The experiments are on a detector of the so-called "crystal rectifier" type, from which, however, the possibility of thermoelectric effects has been eliminated.—S. W. J. **Smith**: The limitations of the Weston cell as a standard of electromotive force. The experiments of Mr. F. E. Smith on cadmium amalgams are discussed. Theory and experiment suggest that there is no range at any temperature over which the E.M.F. of a Weston cell is absolutely independent of the percentage of Cd in the amalgam. Even if the materials are pure, the existence of surface energy must cause some variation. Within the range over which the E.M.F. is usually taken as constant the E.M.F. appears to rise, very slowly, with increase in the cadmium content. The rate varies, but is never more than a few millionths of a volt for 1 per cent. Cd. From the data it seems possible also to discover the precise way in which the use of the richer two-phase amalgams may lead to variability of the E.M.F. of the Weston cell. The interpretation advocated is that the irregularities are due to electrolytic skin effects arising out of want of uniformity of composition of the surface grains. The probable reason why the temperature coefficient of E.M.F. of a Weston cell, always small, actually vanishes near 0° C. is indicated.

Geological Society, May 25.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. F. H. **Hatch** and R. H. **Rastall**: Dedolomitisation in the marble of Port Shepstone (Natal). The Port Shepstone marble is shown by chemical analysis to be a dolomite. It owes its marmorisation to thermal metamorphism by an intrusion of granite, which surrounds it and penetrates it in broad dykes. This intrusion took place at some time prior to the deposition of the Table Mountain or Waterberg Sandstone, and is therefore pre-Devonian. The metamorphism of the dolomite under normal conditions produced a saccharoidal marble of coarse texture, consisting of carbonates; and the fact that neither periclase nor brucite has been produced in the normal marble is taken to indicate that the high-pressure conditions obtaining during the metamorphism precluded dedolomitisation.—E. B. **Bailey**: Recumbent folds in the Highland schists. A description is presented of the stratigraphy and structure of a portion of the Inverness-shire and Argyllshire Highlands. The district considered lies south-east of Loch Linnhe, and extends from the River Spean in the north to Loch Creran in the south. The following conclusions are arrived at:—(1) The schists of the district are disposed in a succession of recumbent folds of enormous amplitude—proved in one case to be more than twelve miles in extent. (2) The limbs of these recumbent folds are frequently replaced by fold-faults, or "slips," which have given freedom of development to the folds themselves. (3) The slipping is not confined to the lower limbs of recumbent anticlines, and is due to something more than mere overthrusting. It is a complex accommodation phenomenon. The cores of some of the recumbent folds have been squeezed forward, so that they have virtually reacted as intrusive masses. (4) In the growth of these structures many of the earlier formed cores and slips have suffered extensive secondary corrugation of isoclinal type.

Linnean Society, June 2.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. A. B. **Rendle** and others: A contribution to our knowledge of the flora of Gazaland: an account of collections made by Mr. Swynnerton, by members of the Department of Botany, British Museum, with notes by Mr. Swynnerton. The collections which form the subject of this paper were made by Mr. C. F. M. Swynnerton chiefly in the high country which forms the boundary between eastern Rhodesia and Portuguese territory. It consists of a number of detached masses of highland separated by river valleys which ultimately unite to form the Buzi, an important river running eastwards through the lower-lying Portuguese territory to enter the Indian Ocean near Beira. Mr. Swynnerton has supplied an interesting account of the phyto-geographical character of the district. There is evidence that it was once covered with dense forest, which has, however, been largely destroyed by the annual forest fires during some form[er] period of dense population. At present the forest occupi[es] the more protected uplands, forming great patches; su[ch] are the great forests in the Chimanimani mountains in t[he] north, a rugged range reaching a height of 8000 feet, a[nd] the Chirinda and Chipete forest patches closely adjoini[ng] each other in the south. Chirinda is described as a virg[in] forest of enormous, and mostly evergreen, trees, coveri[ng] about 12,000 acres of the higher portions of the hill. [The] larger trees range from 80 to 170 feet in height, and t[he] undergrowth, with mosses, ferns, epiphytes, and lianas, [is] of a thoroughly tropical character. As was to be expect[ed] from the geographical position, the botany of these hig[h]lands shows a strong South African affinity, and sever[al] of the genera and a considerable number of the speci[es] have not been hitherto recorded beyond South Africa. [A] large proportion of the plants are identical with tho[se] previously known from Nyasaland. There is also a we[ll] marked Angolan element. An interesting novelty [is] *Pseudocalyx africanus*; Pseudocalyx is a Malagasy gen[us] not hitherto known from tropical Africa.

Mathematical Society, June 9.—Sir Wm. Nive[n], president, in the chair.—G. T. **Bennett**: The compositi[on] of finite screw displacements.—Prof. M. J. M. **Hil[l]**: Differential equations with fixed branch points.—Miss [M.] **Long**: Geiser's method of generating a plane quart[ic] curve.—W. P. **Milne**: The generation of cubic curves [by] apolar pencils of lines.—E. **Cunningham**: The cons[ti]tutive equations of material media in electrodynamics.—Dr. W. H. **Young**: (1) A new method in the theory [of] integration; (2) semi-integrals and oscillating successio[ns] of functions.—H. R. **Hassé**: The transformation of t[he] equations of the theory of electrons for quasi-stationa[ry] motion.

EDINBURGH.

Royal Society, May 2.—Prof. Hudson Beare, vi[ce]-president, in the chair.—Sir Joseph **Larmor**: Address [on] the dynamics of molecular diffusion, with extension [to] suspended particles. After referring to the remarkab[le] parallelism between the phenomena of a free gas, of spar[se] molecules constituting a dilute solution in water or oth[er] fluid, and of the Brownian movements, Sir Joseph pr[o]ceeded to emphasise the distinction between osmot[ic] pressure and gas pressure. The former depended on t[he] frictional pull of moving particles, and the latter on t[he] momentum of the free motion. The zigzag paths [of] particles suspended in water, photographs of which we[re] projected on the screen, suggested that here also, as [in] gases, there was an average free path and an avera[ge] speed to which the power of diffusion stood in defini[te] relations. In this discussion the unexpected resu[lt] emerged that, at the same temperature, the mean spe[ed] was proportional to the number of particles in suspensio[n]. Recent observations under the ultra-microscope, by whi[ch] we can detect particles of a size more minute than can [be] seen by direct optical methods, have not contradicted th[is] conclusion. The analogy between free gases and dilu[te] solutions must not therefore be pressed too far. There w[as] ground for thinking that we were approaching a gre[at] advance in the interpretation of phenomena of this kin[d], namely, the average phenomenon of a great crowd [of] molecules as they affect *en masse* our senses of perceptio[n]. The main interest and fascination of science lay in [its] growing points where new knowledge was gaining grou[nd] on the unknown; and to consider some of the rece[nt] achievements and the outstanding problems in a field n[ow] rapidly undergoing development seemed more suitable [to] such an audience as the Royal Society of Edinburgh th[an] to pass under review once more some harvest alrea[dy] definitely won and safely garnered in the stores of hum[an] knowledge.

May 16.—Prof. Crum Brown, F.R.S., in the chair.—J. W. **M'David**: Equilibrium in the ternary system, wate[r], potassium carbonate, potassium ethyl di-propylmalonat[e]. Crichton had observed that when a concentrated aqueo[us] solution of this last-named salt was shaken up with [a] concentrated solution of potassium carbonate, two distin[ct] layers were formed. The object of the present paper w[as] to show how the miscibility of the two solutions depend[s] on their concentration, temperature, &c. Various solutio[ns]

f the two salts in approximately equal proportions were iixed together and left to settle, and one mixture was iade with quite different weights. Analysis showed that iere was always a considerable quantity of potassium arbonate in the upper layer; but that the amount of otassium ethyl di-propyl-malonate present in the lower iyer was scarcely appreciable until the solutions were omparatively dilute. When water was added drop by rop, the liquid being kept well stirred, the two layers ltimately disappeared, and one homogeneous solution was ft. This disappearance of the two layers was quite well iarked, and was due to the potassium carbonate passing ito the other layer.—Profs. Alex. **Smith** and A. W. C. **lenzies**: A method for determining boiling points under onstant conditions. The apparatus consisted of a small ulb with a bent capillary, the whole being attached to a iermometer suspended in a beaker which contained water, ulphuric acid, melted paraffin, &c., according to the mperature to be measured. The method was especially seful when only small quantities of the material could be sed. The apparatus was also found to be very serviceole in measuring vapour pressures. The authors gave lustrations of its adaptability in a second paper, entitled A Simple Dynamical Method for determining Vapour ressures." In a third communication by the same ithors attention was directed to a common thermometric ror in the determination of boiling points under reduced essure. It was found that appreciable corrections had i be applied when the bulb of the thermometer was iclosed in an evacuated vessel. This was due to the latation or deformation of the bulb. The error might be i much as one-fifth of a degree.—Dr. J. **Brownlee**: The athematical theory of random migration, and epidemic stribution; and the inheritance of complex forms, such i stature, on Mendel's theory. In the former paper, hich was a continuation of an earlier communication, juations were formed which represented closely epidemic stribution, and the distribution which small animals, such i small crustaceans, took up experimentally. The theory d to the exponential curve as an approximate solution, and ie facts were in good accord with the theory. Experients were made with Daphnia, Pulex, Littorina, &c. In e second paper it was shown that the distribution of ich a complex as stature when the dominant elements ere equally derived from both sides may be represented the terms of the trinomial $(1+n+1)^p$. In the case of ndom mating and of equal fertility, $n=3\cdot3$. This point nomial was in Pearson's terminology leptokurtic, that is, e apex had a smaller radius of curvature than the normal irve fitted to the same sets of figures.—Prof. R. J. A. **erry**, Dr. A. W. D. **Robertson**, and K. S. **Cross**:) Craniological observations on the lengths, breadths, and ights of 100 Australian aboriginal crania; (2) a bioetrical study of the relative degree of purity of race of e Tasmanian, Australian, and Papuan; (3) the place in iture of the Tasmanian aboriginal as deduced from a udy of his cranium. These three papers formed a concted series of anthropomorphic investigations, leading to the determination of the Tasmanian race affinities. he statistics throughout were treated in the recognised odern method, in which variability about the mean, rrelation between pairs of dimensions, and the estimaon of deviations were discussed by rigorous mathematical ialysis. Dr. Robertson in the first paper concluded that e difficulty of separating the skulls into sexes rendered advisable to have resulting values obtained for crania r races without reference to sex, and that the Australians, ough less heterogeneous than some other races, were ot as homogeneous or pure as some series which were garded as homogeneous, and that the relationship of eir cranial measurements, as indicated by the coefficient correlation, was low, but was higher than most modern, ough lower than primitive, races. In the second paper, ter a general account of the many conflicting views exessed by various writers, an elaborate comparison was stituted between the cranial characteristics of 86 Tasanian, 191 Papuan, and the hundred Australian skulls of e first paper. The coefficients of correlation for lengtheadth, breadth-height, and height-length showed that, as ready recognised by other investigators, the greatest stress ust be laid on the length-breadth coefficient and the least on the breadth-height. The whole investigation proved that, of the three types considered, the Tasmanian was the purest and the Papuan the least pure. The result supplied a link in the chain of evidence concerning the heterogeneity of the Australian as contrasted with the homogeneity of the Tasmanian. Of the third paper, part i. only had been presented. In this, on the basis of a large number of cranial measurements, the relations of the Tasmanian to the anthropoid apes, Pithecanthropus, *Homo primigenius*, *H. fossilis*, and *H. sapiens* were considered. In part ii. the relations to the Australian aboriginals will be discussed in similar fashion. Twenty distinct measurements of the skulls of fourteen groups were made and tabulated side by side, and from the comparison among these important conclusions were drawn as to the relative evolutionary value of certain measurements. The general results were that, of recent man, the Tasmanian stood nearest to *Homo fossilis* (Brüx and Galley Hill remains), but morphologically had progressed a very long way from *Homo primigenius* (Spy and Neanderthal skulls) and the anthropoid apes, and that Pithecanthropus stood nearer to the anthropoid apes than to *Homo primigenius*.

PARIS.

Academy of Sciences, June 6.—M. Émile Picard in the chair.—H. **Poincaré**: Time signals intended for ships. An account of the system adopted for sending wireless time signals from the installation at the Eiffel Tower. A simple form of receiving apparatus has been designed for the ship, the cost of which is less than that of a chronometer. Signals are sent at midnight and at two and four minutes past midnight, each signal being preceded by an introductory signal.—A. **Haller** and Ed. **Bauer**: The preparation and properties of the β-alkyl-α-hydrindones or the 22-dialkyl-1-indanones. The chloride of the dialkylbenzylacetic acid is obtained from the acid by the use of thionyl chloride. Benzyldimethylacetyl chloride in suspension in petroleum ether is treated with aluminium chloride; the dimethylindanone is readily isolated in good yield from the reaction product. Indanone can be methylated directly by the sodium amide reaction previously described by the authors.—A. **Chauveau** and M. **Contejean**: The formation and elimination of nitrogenous waste in subjects in the state of youth.—Pierre **Termier** and Jacques **de Lapparent**: The monzonite of Fontaine-du-Genie, near Cherchel, Algeria, and on the micromonzonites of the neighbouring region.—R. **Zeiller**: Some Wealdian plants of Peru.—M. **Luizet** and J. **Guillaume**: The appearances of Halley's comet. A detailed account of the varying aspects of the comet from March 1 to May 26.—P. **Cirera** and M. **Urbach**: Observations on the passage of Halley's comet made at the Observatory of Ebra, Spain (see p. 470).—J. Comas **Sola**: Halley's comet. Photographs taken on May 31 and June 1 showed a double nucleus.—M. **Giacobini**: Halley's comet. On June 2 the comet appeared doubled, with two nuclei. Before its passage over the sun the nucleus was sensibly elliptical; after the passage the nucleus became reduced to a point.—Jean **Mascart**: Photograph of Halley's comet. An account of work done at Teneriffe at a height of 2715 metres.—Joseph **Marty**: Singular values of an equation of Fredholm.—A. **Chatelet**: The classification of a system of tables equivalent among themselves.—L. **Zoretti**: The properties of Cantorian lines.—M. **Saltykow**: The generalisation of the theorem of S. Lie.—E. **Barre**: A series of solutions of Lamé's equations of elasticity in a homogeneous and isotropic medium.—Th. **Rosset**: A new sound-recording instrument. A record on a wax cylinder is copied directly on to another wax cylinder by a system of levers. Mirrors are fixed to the levers, and a photographic enlargement of the phonograph trace thus obtained. If the second wax cylinder gives sounds identical with the first, then the photographed record is necessarily a true one.—P. **Pascal**: The accuracy of the methods of measuring magnetic susceptibilities. The methods which have been proposed by the author have about double the accuracy of methods utilising a torsion balance.—A. **Perot**: The mercury arc in a vacuum. The effects produced by varying the conditions of working are described.—Daniel **Berthelot** and Henri **Gaudechon**: The oxidising effects of the ultraviolet rays on gaseous bodies. The peroxidation of the

oxygen compounds of nitrogen and of sulphur. All experiments to cause the combination of oxygen and nitrogen by the action of the ultra-violet rays gave negative results. Nitrous oxide under these conditions gave nitrogen and some of the higher oxides, and nitric oxide behaved similarly. Sulphur dioxide in the presence of mercury gave sulphate of mercury and sulphur, a considerable proportion of the sulphur dioxide remaining unchanged. Sulphur is produced in this reaction even if oxygen is added in excess.—J. O. **Serpek**: The nitrides and oxides extracted from aluminium heated in air. Commenting on a recent note by M. Kohn-Abrest, the author points out that the fact of the production of oxide and nitride of aluminium simultaneously by the combustion of aluminium in air has been known for a long time.—P. **Mahler**: The action of air on coal. Data are given for the amounts of carbon monoxide and dioxide produced by the action of air on coal maintained at temperatures varying between 25° C. and 105° C. This action takes place slowly at the ordinary temperature, and from this it follows that the traces of carbon monoxide which have been found in the air of mines are not accidental, but normal.—Georges **Dupont**: The oxidation of the acetylene γ-glycols. Synthesis of the α-acid alcohols.—A. **Arnaud** and S. **Posternak**: The isomerisation of oleic acid by the displacement of the double linkage. A repetition of the work of Saytzeff on the addition of hydriodic acid to oleic acid, and the subsequent removal of this acid by the action of alcoholic potash, has shown that a very complicated mixture of isomeric acids is obtained. The *iso*-oleic acid of Saytzeff is not a single substance.—Léon **Brunel**: The passage of some aromatic hydroalcohols to the corresponding phenols. The best of the methods examined was found to be that of Sabatier and Senderens, the catalytic dehydrogenation of the aromatic hydroalcohols by passing over hot reduced copper.—MM. **Stœcklin** and **Crochetelle**: The accidental presence of sulphocyanides in milk and their origin. Sulphocyanides may be introduced into milk when certain Cruciferæ enter into the food of the cow.—Raoul **Combes**: The simultaneous production of oxygen and carbon dioxide in the course of the disappearance of the anthocyanic pigments in plants. It is shown that the simultaneous evolution of oxygen and carbon dioxide is more general than has been hitherto supposed, and always occurs when the acid pigments are disappearing.—H. Jacob **de Cordemoy**: The influence of the medium on the variations of the secreting apparatus of the Clusiaceæ.—A. **Contamin**: The resorption of experimental tumours of mice under the influence of the X-rays. The results of a histological study of the resorption of a glandular epithelioma under the influence of the X-rays.—Mlle. Boleslawa **Stawska**: Studies on cobra venom and the anti-venom serum.—M. **Fougerat**: The homologies of the muscles of the posterior member of reptiles.—M. **Rose**: Some tropisms.—G. **Seliber**: The symbiosis of the butyric bacillus in culture with other anaërobic micro-organisms.—Jean **Bielecki**: The variability of the proteolytic power of anthrax bacteria.—V. **Roussanof**: The Palæozoic strata of Nova Zembla.—A. **Doby**: A fossil-bearing horizon in the *Muschelkalk* of Bourbonne-les-Bains (Haute-Marne).—Jean **Boussac**: The Helvetian Nummulitic and the pre-Alpine Nummulitic in central and eastern Switzerland.—M. **Roman**: The Rhinoceri of the European Oligocene, and their connection.—M. **Fournier**: The nodules (Septaria) of the Triassic ammonites of Madagascar, and on the development of Ammonea.

DIARY OF SOCIETIES.

THURSDAY, JUNE 16.

ROYAL SOCIETY, at 4.30.—Experimental Researches on Vegetable Assimilation and Respiration. VI. Some Experiments on Assimilation in the Open Air: D. Thoday.—A Case of Sleeping Sickness studied by Precise Enumerative Methods: Regular Periodical Increase of the Parasites Disclosed: Major R. Ross, F.R.S., and David Thomson.—The Recognition of the Individual by Hæmolytic Methods (Preliminary Communication): Dr. Charles Todd and R. G. White.—Receptors and Afferents of the Third, Fourth, and Sixth Cranial Nerves: Miss F. M. Tozer and Prof. C. S. Sherrington, F.R.S.—(*a*) Trypanosome Diseases of Domestic Animals in Uganda: (1) *Trypanosoma pecorum*; (*b*) Experiments to ascertain if Cattle may act as a Reservoir of the Virus of Sleeping Sickness (*Trypanosoma gambiense*): Colonel Sir D. Bruce, F.R.S., and others.—The Lignite of Bovey Tracey: Clement Reid, F.R.S., and Eleanor M. Reid.

LINNEAN SOCIETY, at 8.—Inheritance of Sterility in Potatoes, with Remarks on the Shapes of the Pollen: Dr. Redcliffe N. Salaman.

MONDAY, JUNE 20.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Features of Alpine Scenery due to Glacial Protection: Prof. E. J. Garwood.

TUESDAY, JUNE 21.

ROYAL STATISTICAL SOCIETY, at 5.

FARADAY SOCIETY, at 8.—Studies in the Electrometallurgy of Ferro-alloys and Steel: P. Girod.—The Failure of the Light Engineering Alloys, particularly the Aluminium Alloys: E. F. Law.—New Types of Mercury Vapour Lamps: Dr. F. Mollwo Perkin.

THURSDAY, JUNE 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Damping of Sound by Frothy Liquids: A. Mallock, F.R.S.—Dispersion of Light by Potassium Vapour: Prof. P. V. Bevan.—Additional Refractive Indices of Quartz, Vitreous Silica, Calcite and Fluorite: J. W. Gifford.—The Absorption Spectra of Sulphur Vapour at Different Temperatures and Pressures and their Relation to the Molecular Complexity of this Element: J. I. Graham.—The Wave-making Resistance of Ships; a Study of certain Series of Model Experiments: Dr. T. H. Havelock.

FRIDAY, JUNE 24.

PHYSICAL SOCIETY, at 5.

CONTENTS.

THURSDAY, JUNE 23, 1910.

INDIAN ENTOMOLOGY.

ıdian Insect Life; a Manual of the Insects of the Plains (Tropical India). By H. Maxwell-Lefroy, assisted by F. M. Howlett. Pp. xii+786. (Calcutta and Simla: Thacker, Spink and Co.; London: W. Thacker and Co., 1909.)

THIS handsome volume reflects great credit upon its authors, who occupy the posts of ento-ologists to the Imperial Department of Agriculture r India; and also upon the staff of the Agricultural esearch Institute at Pusa, under the auspices of hich the observations and specimens have been col-cted on which the present work is based.

In some prefatory remarks Mr. Maxwell-Lefroy forms us that the book is largely a product of his are time and scanty holidays, adding that "such volume has been so much required that he has lt that even an imperfect one was better than none." is estimate of his own work is modest—

It may be," he says, "that a better volume will be iilt up on this basis, when the study of Indian ento-ology is further advanced. I may also emphasise the ct that where little is said, little is known, and the anks in the book are designedly prominent to empha-se the enormous scope there is for work. I trust also at the volume may be a real stepping-stone to tter things, and may help those who are advancing ır knowledge of the insect life of India."

:aring in mind the limitations thus indicated by the ıthor himself, we cannot but congratulate him and his ilaborators on the amount of useful information they ıve contrived to embody in their work, and on the re which has evidently been expended on its get-up ıd general appearance. So sumptuous indeed is the ›ok in these latter respects that the title of Manual" seems to be somewhat of a misnomer.

A marked feature of the book is its admirable series illustrations. These have mostly been prepared by e artist staff of the Pusa Institute. Both the half-ne blocks and the line engravings show good work-anship; while the colour-plates, carried out by the ılcutta Phototype Company, "under very trying matic conditions and for the first time in India," bear mparisen with the best of their class. Many of the tists engaged on these illustrations are, we are formed, natives of India, trained in art schools of at country. Their work is highly creditable to all ncerned.

The plan of the book is simple. It opens with an troduction of about forty pages, in which are briefly scussed the structural characters of the class Insecta, ith its position in the zoological scale, the instincts ıd habits of insects, their classification, and the inciples of nomenclature as applied to the group. ıe methods of identification of specimens and the isting appliances for the study of entomology in dia are also noticed, and a section is devoted to a eful exposition of Indian zoogeography. The food ıd habitat of insects are dealt with in a practical anner, and the introduction closes with a reference to the beneficial and other activities of insects in relation to man.

Following the introduction comes a systematic account, profusely illustrated, of each of the nine orders into which for present purposes the authors divide the class of insects. There is, of course, much divergence of opinion, and more of practice, among entomologists on the subject of classification; and the authors do wisely in warning the student against "getting to attach too much importance to any classification systems except as working conventions which have as much regard to truth as circumstances will allow." The characteristics of each order, and those of its subdivisions, are carefully given, and the most noteworthy specific forms under each head are more or less fully dealt with, sometimes, especially those of economic importance, in considerable detail. Many valuable observations on habits and life-histories are incorporated in this portion of the work, which covers the ground in as satisfactory a manner as could be expected from the limited space at the authors' disposal.

Finally, we have, somewhat after the manner of the excursuses in Scudder's well-known work on the butterflies of the eastern United States, a number of brief treatises of a general kind, dealing with such subjects as cosmopolitan insects, gregarious habits, attraction to light, insects and flowers, migration, deceptive colouring with other means of protection, galls, silk, the size of insects, and insect noises. These essays, which are interspersed among the systematic sections of the book, include observations many of which are of great interest and value. As an example of a good field observation, which many travellers will be in a position to confirm, we may cite the following:—

"If one goes into a grass field, intent on observing large grasshoppers, one will suddenly see a brightly coloured insect jump up, fly a little distance and disappear. . . . The eye has followed the bright colours and loses the insect as these disappear with the closing of the wings at the completion of the flight. One's eye is not seeking the cryptically-coloured grasshopper, which thus escapes attention, even if one could easily see the motionless insect."

The modesty of the claims put forward by the authors tends to disarm criticism; nevertheless, it may perhaps be suggested that some of the topics, especially those dealt with in the introduction, might with advantage have been treated more fully. It is unfortunate, too, that the authors allow themselves to be influenced by the somewhat silly outcry that has been raised in some quarters against bionomic conclusions "drawn from museum specimens." No naturalist ought to undervalue either museum study or field observation. Each is an essential factor in unravelling the problems of evolution, and each has furnished the other with important suggestions for further research. Field work on mimicry, in especial, owes much to the stimulus afforded by the careful study of material preserved in collections.

We do not agree (p. 419) that there is much difficulty in distinguishing *Terias hecabe* in all its forms from other species of Terias, nor that the colouring

of the upper surface of *Coletis* (or *Teracolus*) *amata* is well described as "orange." "Thaxter" on p. 405 is a misprint for Thayer. These, and a few similar slips, are but slight blemishes on a thoroughly useful book. F. A. D.

THEORETICAL STUDIES IN RELATION TO NAUTICAL SURVEYING.

Hydrographic Surveying: Elementary—for Beginners: Seamen and Others. A Practical Handbook. By Commander Stuart V. S. C. Messum. Pp. xiv+504. (London: C. Griffin and Co., Ltd., 1910.) Price 12s. net.

THEORETICAL considerations dealing with the effect of errors of observation constitute one of the distinctive features of this book. It may be doubted whether such investigations are appropriate to a practical handbook intended for beginners; and in some instances, where they are merely of academic interest, their introduction is unnecessary. The dissertations on the manipulation of the station pointer, for example, are diffuse and of little practical utility. The chapter on the principles governing the selection of objects for fixing positions contains certain theorems which will be of interest to those already familiar with the subject; but beginners would find concise directions as to what goes to make a good fix more helpful to them. The discussions bearing on the "circle of equivalents" bring out a useful fact in a form somewhat different from that in which it has usually been presented. The principle involved is an important one, but it is possible to strain unduly its practical application. So much stress has been laid on it that beginners might easily be misled; the author himself appears to have misapplied the principle on more than one occasion.

This is notable in the example of plotting given on p. 197, where it is suggested to accept an intersection of two lines cutting each other at an angle of a little more than 30°, in preference to an intersection of about 90°. In this case primary points are alone concerned, and the considerations indicated by the author are not applicable. A similar misapprehension is noticeable on p. 201, in the paragraph relating to the projection of check lines from the best lines of reference. It is here implied that in the case of primary points, one of the lines on which they are plotted might have been laid off with a length of radius so short as to vitiate any lines laid off from it subsequently.

The question is discussed at some length as to the best zero to select for shooting up other objects when the position of the observer is not accurately determined. The problem is one of frequent occurrence, and is of great importance, but the treatment it receives is not satisfactory, and is liable to misapprehension. In this, as in some other cases, the broad practical rule of choosing a zero situated at about the same distance as the object to be shot up and making as small an angle with it as possible is not stated; whilst the investigation rests on assumptions not realisable when drifting in a boat or the ship in an unknown direction, as always happens in practice. In the paragraph on measuring a base by chained portions, the rule of sines is used for solving triangles having one very obtuse angle and two acute angles. The proper method of solving such triangles might have suggested to the author the fact that since cosines of small angles change very slowly, small errors of observation are practically of no account, and consequently that the measurement of the off-set is unnecessary and less accurate than using each separate section of the base as measured.

Other instances of misapplication of theory to practice might be quoted, but those mentioned suffice to indicate a want of appreciation of practical requirements, and suggest the possibility that the author is more familiar with the theoretical study of the subject than with the conduct of a survey.

In discussing the question of false station, there is no reference to the simple method of eliminating all errors from that source by the expedient of observing at equal distances on opposite sides of the true station. There is, moreover, an easier method than that given by the author for calculating the correction for false station.

The use that might be made of a distant peak in connection with the angle of elevation of the mast-head when sounding a shoal has also escaped attention; neither is there any reference to the use of angles of elevation in making a running survey of an island when circumstances admit.

The investigation of the error of parallax in connection with sextant angles, due to the use of the long telescope when reflecting objects close to the observer, is of some theoretical interest, and is worthy of mention. As a matter of fact, the error from this source is not nearly so great as the author assumes, since it only exists in a minor degree with the short telescope which in practice is always used, being more convenient.

The various instruments and the methods of using them are fully described, and the ordinary operations connected with surveys of small extent are given in detail, together with a number of examples of such surveys, besides a useful chapter on amending the details of a chart. A. M. F.

PRODUCTION OF SEED-OILS.

Linseed Oil and other Seed Oils: An Industrial Manual. By Prof. W. D. Ennis. Pp. xiv+31[illegible] (London: Constable and Co., Ltd., 1909.) Price 16s. net.

IN this work the author aims at the production of a manual which will serve as a fairly complete guide for the manufacturer of certain seed oils, more particularly linseed oil. He notes that, with one or two exceptions, the principal publications dealing with this subject hitherto have discussed it chiefly from the chemical standpoint. Accordingly in this volume the chemistry—which, after all, is relatively simple—is subordinated to the manufacturing and commercial aspects of the industry.

The work is written from the American point

view, and this no doubt detracts somewhat from its value to the English manufacturer. On the other hand, the latter will probably find some compensation in seeing how his problems are regarded by other eyes.

After a short historical description, the first eight chapters deal with the standard forms of equipment used in extracting oil from seed by the pressure process. Such matters as the location and planning of the mill, the selection of the best type of apparatus, the handling of the seed, the treatment of the oil, and the moulding of the oil-cake are discussed in ample detail. Economical production is kept in view throughout.

In the second and some later chapters we come across pages of algebraical formulæ which at first sight look like extracts from a mathematical textbook. They are the author's method of analysing in general terms various problems of manufacture, in order to show definitely the effect of adopting certain processes or courses of treatment. For example, the question is discussed algebraically whether in given circumstances it pays best to separate the "screenings" from the seed and sell them, or to pass them through the mill with the seed, or, thirdly, to separate them and grind them up with "cake." When all the factors have been combined into a formula, the man with an eye for an equation can readily see what effect an alteration in any factor will tend to produce. The man not endowed with such an eye can readily puzzle the matter out, and be all the better for the exercise. In such a way an intelligent control over the operations can be maintained.

In the subsequent chapters the method of extracting oil from seeds by percolation with a volatile solvent is described and discussed. Only about 10 per cent., however, of the oil produced in the United States is obtained in this manner.

Questions of output, shrinkage, and cost of production are dealt with at some length; and there are chapters on refining, on boiled oil, and on miscellaneous seed oils. The author contrasts the great development of the cottonseed oil industry in the United States with the comparative neglect shown in regard to other oils—linseed excepted. Rapeseed oil is the most conspicuous failure; but more olive oil should be produced, he thinks, in California, more cocoa-nut oil on the Pacific coast, and more pea-nut oil in the eastern States.

A section on the chemical characteristics of linseed oil gives briefly the chief items which the oil-works chemist requires to know. Information on various technical points, collected from scattered trade journals, has also been included, and certain official rules and regulations, such as those of the New York Produce Exchange and the Minnesota Grain Commission, have been laid under contribution in respect of the commercial aspects of the industry.

Many illustrations of apparatus are given, and the treatment is throughout of eminently practical character. Probably there are few intelligent oil manufacturers who would not be able to get at least some useful hints from the book. C. S.

ZOOLOGY OF THE INDIAN OCEAN.

An Account of the Alcyonarians collected by the Royal Indian Marine Survey Ship "Investigator" in the Indian Ocean. By Prof. J. Arthur Thomson and J. J. Simpson. Part ii., The Alcyonarians of the Littoral Area. With a Report on the Species of Dendronephthya by Dr. W. D. Henderson. Pp. xviii+319+ix plates. (Calcutta: Indian Museum, 1909.)

THE first part of the memoir of the Alcyonarians of the Indian Ocean was published in 1906, and reviewed in NATURE of May 2, 1907. The second part deals with the shallow-water species, and fully maintains the high standard set by the first in wealth of detail and sumptuous illustration.

The authors of this volume have set themselves a task which is far more difficult than that of naming and describing the deep-sea species, and they have faced it boldly and, on the whole, satisfactorily. In the order Alcyonaria there are certain genera of wide distribution in tropical shallow waters which exhibit an infinite variety of form, of mode of branching, of colour, and of detail in skeletal characters, and the zoologist to whom the task is assigned of naming the spirit specimens sent to him by the collectors has to form an opinion as best he can on the vexed question of what characters or groups of characters in combination are sufficiently important to constitute a specific difference. In the absence of any knowledge of the development of the colonies, or of the relation of the different forms of growth to their surroundings on the reef, or of the transmission by heredity of the different characters he uses for purposes of classification, his opinion is rarely one of very great scientific value. Nevertheless, if his task is conscientiously performed, his descriptions accurate, and his illustrations adequate, our science is enriched by a number of recorded facts which may be of considerable value when the solution of the underlying biological problems is seriously taken in hand.

No better illustration of this difficulty could be found than that of the genus Spongodes, so excellently treated in this volume by Dr. W. D. Henderson. Following the example of Prof. Kükenthal, in whose laboratory he worked for some months, Dr. Henderson has distributed the specimens in the collection among no fewer than sixty-one species, of which fifty-three are described as new to science. But the question must occur to anyone who has seen Spongodes in abundance in its natural surroundings whether these numerous species could be maintained, even by the author himself, if another consignment of the same or greater dimensions were sent to him from the same locality. There is an advantage and a disadvantage in creating a large number of specific names for a common genus like Spongodes. It enlarges our knowledge by giving us detailed descriptions and illustrations, and in so far as it does that it is a gain; but, on the other hand, it tends to underestimate the importance of what may be a very definite character of all these common shallow-water genera, the power of adaptability to their immediate

surroundings. An animal that is able to move about can, within certain limits, choose its own immediate surroundings, and is not, therefore, so much in need of adaptability, but a sedentary animal or colony of animals must either adapt itself to the surroundings of the spot to which the larva happened to become fixed or it must perish. The evidence that there is really more than one variable species of Spongodes does not appear to be at all conclusive, but it is at any rate satisfactory to feel, when we contemplate the results of Dr. Henderson's labours, that we have some further knowledge of the varieties of form it may assume.

One word of protest may be said about the use of the generic name Dendronephthya for Spongodes. Whether the application of the strict rules of priority justifies the change or not, and those who study the literature of the genus may fairly claim that it does not, the inconvenience and confusion which the change of such an old and well-known generic name as Spongodes introduces are quite sufficient justification for our refusal to accept it.

As might be expected in the description of a shallow-water fauna, the number of new genera (four) is very small. Of these the curious cup-like genus Studeriotes, with its retractile polyparium, is the most interesting. The new nephthyid Cactogorgia, with its dense armour-plated walls of large spicules, is a remarkable example of the extreme limits to which spiculation in the Alcyonaria may be carried.

The suggestion made by the authors that the genus Chironephthya should be fused with Siphonogorgia is clearly a move in the right direction.

Among the many useful and valuable features of the volume, attention may be specially directed to the summary of the characters of the pennatulid genus Pteroeides. A hope may be expressed that before long a similar summary of the genera and species of the Juncellidæ may be published. This family is evidently under the consideration of the authors, but in the present volume they have only given a tabular statement of the specimens in the collection, without assigning them to specific groups. The excellent coloured plates and numerous illustrations in the text add very materially to the volume, which is a very noteworthy addition to our knowledge of the Alcyonaria.

S. J. H.

THE PHYSIOLOGY OF THE PROTOZOA.

Einführung in die Physiologie der Einzelligen (Protozoen). By Dr. S. von Prowazek. Pp. v+172. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 6 marks.

THIS work differs from all other treatises on the growing subject of protozoology in being largely devoted to the problems of function. It is a condensed account of our present knowledge of this highly important and difficult subject, and consists of summaries of physiological results, often too short to be easily intelligible, but of considerable value to that increasing number of investigators who are interested in recent advances in this field. The author is a well-known and active worker, and does not hesitate to press certain views which have not as yet obtained complete adherence. On the whole, however, he gives an impartial view of the state of each problem so far as the kaleidoscopic nature of the case allows.

With regard to the question of protoplasmic structure, von Prowazek concludes that Bütschli's alveolar theory does not account for all the facts. He holds that protoplasm may be absolutely structureless, and must, therefore, be regarded as polymorphic. Each protozoan cell is, according to him, at least binuclear. This view, though well known to be shared by Hartmann, is not generally accepted, and it would have been advisable for more and better figures of the nuclei of such common forms as those of amœba to have accompanied the statement, which, as it stands, is not rendered quite convincing, though we are aware of the evidence in its support. The functions of the nucleus are dealt with at some length, and their discussion involves the consideration of much experimental evidence; in fact, it would be difficult to name any function of the organism which is not assigned by some writer to the activity of the nucleus. Form, motion, enzymes, or at least proenzymes, respiration, division, reproduction, heredity, regeneration, are all more or less confidently assigned to this versatile structure. Not only are its functional activities increasingly stressed, but the importance of the nucleus in originating structures hitherto supposed to be cytoplasmic is also fully considered. An interesting exception that is noted in this discussion is the fact that amœbæ can live for at least a month without a nucleus, and a portion of a Stentor deprived of its nucleus may regenerate the lost parts of its body.

Attention is directed to the importance of the membrane that encloses the protozoan cell, and to the mode whereby osmosis or absorption is performed. The suggestion of Overton that the membrane contains "lipoids" (*e.g.* lecithin and cholesterin), and that these take an active part in the absorption of substances into the cell, is somewhat over-emphasised, since it is by no means certain how far these "lipoids" contribute to the formation of the ectoplasmic structures. At the same time, so much attention is now being paid to this aspect of biochemistry that the discussion is a very timely one and should lead to further research.

The latter half of the book is occupied by summaries of what is known as to the functions and "tropisms" of protozoa. With regard to respiration, attention is directed to the natural or induced anærobic character of many ciliates as well as to the behaviour of other infusoria when supplied with excess of oxygen. Loeb's view that the presence of a nucleus is essential to the oxidation of the cell is not upheld. An interesting account is given of the nutrition and movements of protozoa, but the behaviour of forms such as amœba, which contain chlorophyll corpuscles, is almost entirely neglected, in spite of the work of Grube and Doflein, and there is room for direct observation on the supposed ingestion of bacteria in the case of many infusoria. With regard to the significance of fertilisation, the author concludes very much in the sense of Doflein as given in his recent

large work, reviewed in this journal on March 3. The act is regarded as one of harmonising the discrepancies that arise through specialisation of chromatic and motor organs in the male, and of assimilative structures in the female.

In conclusion, we have to regret the absence of an index or of a list of references, but we may recommend the work as an extremely useful and compact summary of recent work on the physiology of the protozoa.

AMATEUR ASTRONOMY.

An Easy and Concise Guide to the Starry Heavens, arranged as a Companion to the Umbrella Star Map and Revolving Star Dome for Instruction in Astronomy. By D. McEwan. Pp. 137. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1910.) Price 5*s*.

THE idea of using the concave surface of an umbrella as a star map is excellent, but, of course, not new. The portability and convenience of manipulation of such a stellar guide are obvious advantages, while the aspect in which the constellations are seen, unlike the view in a celestial globe, corresponds to the reality. The actual construction of such a chart of the sky might quite well form part of the practical work of every elementary course of astronomy.

A simple guide to the heavens, to be used in conjunction with, and in explanation of, such an adapted umbrella should be worthy of notice. It is to be regretted that the present book, while pretending and seeming at the first glance to fulfil just such a function, cannot be recommended. Somewhat scrappy and not always trustworthy, it gives the impression of being the work of an amateur.

After a preface and an introduction, chapter i. devotes a page and a half to astronomical magnitudes and units, and also describes a chart of the north circumpolar stars, which is reproduced. The stars contained in the various "segments" of the "Umbrella Star Map" are dealt with in chapter ii. The persistently miscalled "segments" are really the sectors formed by the ribs and circumference of the umbrella. In the text a certain amount of information is given about the constellations and the principal stars as they occur in each "segment," while charts show their relative positions and make a very rough attempt to indicate stellar magnitudes. The scheme to represent magnitude described for the actual umbrella is not in use, apparently, in the companion book. A separate key-map in each case is used to indicate names. A table, giving for each star a serial number, the Greek letter, constellation, magnitude, right ascension, and declination, completes the information for a typical "segment." General astronomical information is introduced relative to special objects as they are encountered, so that, without reference to the index, it is difficult to find the treatment of any particular subject.

The information given is often amateurish and sometimes in error, while plausible misstatements which would trouble a beginner are to be found. The solar spectrum, for example, is "well known to consist of the seven colours," while by observations made through a long tunnel, or from the bottom of a well, "any star coming into the field of view would be seen even in daylight." Under the title "Major Planets" are described Jupiter, Saturn, Uranus, and Neptune, while the "Minor Planets" are Mercury, Venus, and Mars. To Jupiter is ascribed only five moons, the date of discovery of the fifth being given.

Chapter iv. describes a folding key to the "Umbrella Star Map," and the next chapter deals with the solar system in a bald way. In the pages devoted to time, the sun is described as being due east at six o'clock, while amplitude is misdefined in the following chapter.

A section devoted to scouting and an index to constellations bring to a conclusion a book which needs a thorough revision if it is to be of service.

ELEMENTS OF PHYSICS.

(1) *A First Book of Physics.* By Dr. L. Lownds. Pp. vii+145. (London: Macmillan and Co., Ltd., 1910.) Price 1*s*. 6*d*.

(2) *An Elementary Text-book of Physics.* Part IV., Heat. By Dr. R. W. Stewart. Pp. iv+246. (London: C. Griffin and Co., Ltd., 1910.) Price 3*s*. 6*d*. net.

(3) *Matriculation Magnetism and Electricity. A Text-book for Use in Schools and Colleges arranged for Modern Methods of Teaching.* By Dr. R. H. Jude and J. Satterly. Pp. vii+415. (Cambridge: University Tutorial Press, Ltd., 1910.) Price 4*s*. 6*d*.

(1) THIS book is intended for those beginning the study of physics. The contents do not cover the whole ground usually dealt with, but are confined to the principles of measurement, mechanics, and heat. The reason given for this is that it is now customary in secondary schools to limit the courses of study to these subjects for the first two years. Students reading this book are expected to be acquainted with the elements of mathematics, and to be able to perform for themselves the numerous experiments described in the text. Descriptive and numerical test questions form the conclusion of each chapter.

There is no doubt it will be found a very useful book. The most pleasing feature is the exactness with which statements are made, at the same time preserving great simplicity of language. Added to this, the printing and diagrams are good, and advantageous use is made of heavy type for the more important statements of principles.

(2) Dr. Stewart's fourth volume is written in much the same style as the three preceding ones. It is suitable for those possessing no previous exact knowledge of the subject of heat. Attention is paid to all the elementary thermal phenomena, the order of treatment being the usual one. What has been said above in reference to Dr. Lownds's book applies also here. Few difficulties should present themselves to an earnest reader of the subject. Here also many experiments are described, but, with the exception of a few worked in the text, examples are absent.

There is rather a surprising omission, however, in the chapter on the transference of heat by radiation.

Although the essential similarity of light and radiant heat is insisted upon, and the distinction between heat and radiant heat clearly drawn, no experiments to illustrate the application of the laws of reflection to the latter are given. The experiment with two concave mirrors in which heat is transferred by radiation from one focus to the other is surely one of the best for impressing on students the connection between the various radiations.

(3) This much longer volume is not nearly so good as those just commented upon. It is written specifically for the London matriculation examination, and it may be said at once that it is much too difficult. It would have been better if less material had been treated more fully. As it is, the book is overcrowded with statements which it would be impossible for the elementary student to deduce for himself—he must merely commit them to memory. He is told, for instance, that the "dyne" is the weight of one gram divided by 981, a statement which is not only incorrect, but conveys no impression of the importance of the absolute unit of force. A long discussion is entered upon as to the relative merits of the two-fluid and one-fluid theories of electricity. The matriculation student is advised in the text to accept the one-fluid theory, and then a footnote tells him that probably he will have to revert to the two-fluid theory because recent experiments point to the existence of positive electricity. Controversies of this kind are altogether out of place in elementary text-books; they only confuse the student.

There is a profusion of examples at the end of each chapter. These are, as a whole, good; but it is doubtful whether the pupil would be in a position to answer them intelligently if left to himself.

OUR BOOK SHELF.

Studien über die Bestimmung des weiblichen Geschlechtes. By Prof. Achille Russo. Pp. v+105. (Jena: Gustav Fischer, 1909.) Price 3 marks.

PROF. Russo has published a general account of very interesting experiments which he has made on the determination of the female sex in rabbits. His method was to dose the animals with lecithin—a well-known constituent of yolk of egg—administering it in various ways. He injected it into the peritoneal cavity or subcutaneously; he even introduced it through the mouth. From control experiments it seemed clear that one of the results of introducing the lecithin in considerable quantity into the system, where it normally occurs in many different tissues, was the accumulation of deutoplasmic material in the ovarian follicles and in the oocytes; and Russo found that rabbits treated in this way, and subsequently mated, had more female than male offspring. Sometimes all the offspring were female. The security of the conclusion that the lecithin treatment was the condition of this disproportionate number of female offspring depends on the number of cases investigated and on the avoidance of selected stocks. Russo is well aware of this, and he does not betray any dogmatism.

In the normal ovary, or in what he believes to be the normal ovary, Prof. Russo distinguishes two kinds of ova, one kind rich in nutritive material deposited in the zona pellucida and in the vitellus, the other kind with little or none. The lecithin treatment increases the number of the richly equipped, highly anabolic ova, and they are (if the correlation has been adequately substantiated) the female-producing ova.

In young rabbits of five or six months the ova show little vitelline material, no chromidial corpuscles, and a clear zona pellucida. This is a sign of deficient nutrition, and there is some evidence that these very young ova tend to be male-producing. As the nutrition of the ovary improves with age, the ova become better equipped with "embryoplasmic" material, and tend to be female-producing. The general result of Prof. Russo's interesting experiments is to show that the ovary is a very plastic organ, responding to the lecithin treatment by an increase in the number of female-producing ova. He suggests that the lecithin treatment of males may affect the spermatozoa in an analogous way—in their mitochondrial apparatus. In developing his thesis, the author communicates many valuable observations on the germinal epithelium, the granulosa, the zona pellucida, and the various chromatic substances which appear in the ooplasm. Statistics of the experiments and details as to methods employed are duly submitted, and the whole discussion is conducted in an admirable scientific temper.

Report on the Mines and Mineral Resources of Natal (other than Coal). By Dr. F. H. Hatch. Pp. xii+155+vii plates. Published by order of the Natal Government. (London: Printed by R. Clay and Sons, Ltd., 1910.)

THIS little volume, which contains the results of an eight months' prospecting trip in the colony of Natal, undertaken by Dr. Hatch on behalf of the Natal Government, is extremely disappointing, as the only conclusion that can be drawn from it is that Natal possesses no mineral, other than coal, that is deserving of any serious attention. Dr. Hatch sums up his impression in the words, "no large well-developed metal mines, either of the precious or of base metals, exist in Natal." To which may be added that the report indicates that no deposit has yet been met with which promises to be worth developing or to be likely to be mined with any measure of success, and the same is true of the non-metallic deposits—coal, of course, being always excepted. Deposits of gold, copper, tin, iron, manganese, chromium, lead and silver, molybdenum, of limestone, phosphate, graphite, asbestos, gypsum, salt, nitrate, oilshale and petroleum, building stone, slate, clay, &c., are known to exist and have here been reported on, but nothing of commercial value seems to have been met with anywhere. The value of the mineral output of Natal for 1908 is given as 741,158*l*., out of which the value of the coal is 737,169*l*. Further comment is needless.

Modelling from Nature. A New and Original Method of Clay Modelling. By Lilian Carter. Pp. 32; and 16 plates of models copied from nature. (London: Cassell and Co., Ltd., n.d.) Price 1*s*. 6*d*. net.

THOUGH we are sceptical as to the newness and originality of Miss Carter's method of teaching clay modelling, there is no doubt that work of the kind she describes interests young children, and assists in making them accurate and alert in examining natural objects, as well as deft with their fingers.

The Time of the Singing of Birds. Pp. 126. (London: Henry Frowde, 1910.) Price 3*s*. 6*d*. net.

THIS anthology of verse will appeal to all bird-lovers. Three compilers have been able, with the cooperation of authors and publishers, to bring together a charming collection of modern poems, as well as the better known older verses dealing with bird life.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Tail of Halley's Comet on May 18–19.

PERHAPS the following observations I made of Halley's comet on the night of May 18, when it crossed the sun's disc, may be of interest as a record.

On that evening I crossed by steamer from Palermo to Naples, as I wished to have a clear horizon all round to see what would happen. The vessel leaves Palermo at 7 p.m. and arrives at Naples at 7 the following morning, and it seemed the best place for a view.

I may say that I had been watching the comet every night from May 7, and was quite familiar with its appearance. I say this because it was quite different from that of any other comet I can remember. The first time I saw the tail was when I came on deck on May 7 about 4 a.m.; the nucleus was not visible, but right across the sky was a long white streak just like a cloud, quite as opaque as a cloud, and I could not believe it was the tail of the comet at all; but on coming on deck the next morning at 2.15 I saw the same white streak, but this time with the nucleus, also of a very white colour.

I had no instrument with me to measure the length of the tail, but I got the quartermaster to lay it off on the ship's compass; he put it down on paper; it was E. ½ N., and the end of the tail was E. by S. ½ S., which is about 22½° horizontal measurement; the real length of the tail itself I could only estimate as "about half-way across the sky."

On the night of May 18, as soon as it got sufficiently dark, the tail was plainly visible; there was a ten-days' old moon which rather interfered with the view, but about 2 a.m. it had got sufficiently low and behind a thin but convenient bank of cloud, so that it did no further harm to my observation. Of course there was no nucleus to be seen; that was down below with the sun, but the tail was quite different in character from that which I had seen on the previous nights. It was not a long streak of white, but a confused mass of pinkish light extending along the horizon for 40° or 50°, and then stretching right across the sky, coming gradually to a point at the wide naked-eye double star (α and β Capricorni) below Altair, in line with the three stars. The tail narrowed in on its course upwards, and passed just below the Great Square of Pegasus, γ Pegasi being well in the tail, but α Pegasi was clear of it.

I continued watching the tail for shooting stars in its neighbourhood, but I only saw three or four; there was nothing particular about them, except that they seemed to start from the edge of the tail, which was well defined, and only travelled 4° or 5° from it.

But there still remains a curious sight to describe which I saw on the other side of the ship.

About 2.15 a.m. I went aft to get the time from the chart-room clock, and, happening to look over the port side of the ship to the west, I saw a pillar of light on the opposite side of the earth to that from which the comet's tail came up; it was about 45° (roughly) high and 50° or 60° broad at the horizon; it was straight up and down, and was much brighter in the middle than at the sides, and the bright part seemed like a pillar of light, but the lighter and more transparent sides came up and formed a large cone. The setting moon was a good deal to the right of the cone, and was somewhat clouded out, and had no connection with it. At the time I took the cone to be the Gegenshein, and did not pay much more attention to it, beyond looking now and then to see that it was still there.

Both the cone and the tail were visible from 2.15 to 3.5 a.m. It is quite possible that at this time the earth may have been passing through some of the tail, and had divided it in two.

I was up at Monte Casino the next night; unfortunately a fog came down on the mountain, but I heard that at the observatory they had seen an arch of light over the part of the horizon from which the tail came. I did not see this; but I was at sea-level, and the observatory is up some 1500 feet. HOWARD PAYN.

20 Hyde Park Place, London, W., June 17.

AN observing party was organised at this college for the purpose of taking note of any physical disturbances which might occur during the passage of the earth through the comet's tail, particulars of which will be published later. Our object in now writing is to put on record a remarkable appearance which presented itself at about 3.30 on the morning of May 19.

The comet has been visible here to the *unaided eye* since April 12, and up to the morning of May 18 the tail presented what may be termed a normal appearance, *i.e.* smaller at the nucleus than at the extremity, but on the morning of May 19 the character had altogether changed. At about 3.30 a luminous patch was seen at an altitude of about 20° from the horizon, and in the place where the tail formerly appeared. There were some clouds near the horizon, and as these cleared away the whole of the tail became visible, extending at 4.30 right up to the zenith, and there being lost in the Milky Way.

When there were no clouds the sky was remarkably clear, the Milky Way shining most brilliantly. The light from the tail of the comet was polarised, but not so distinctly as was the case with the normal tail on previous mornings. The tail persisted until daylight. It, to some extent as regards shape, simulated the Zodiacal Light, but at the same time was essentially different, and did not appear in the usual situation of the light, as it was many degrees to the north of the sun. It was much longer, narrower at the base, and ten times brighter. There is no question but that it was the comet's tail.

At 4.30 the upper half of the tail was quite free from cloud, and the gradual narrowing towards the upper end was most marked. It seemed from the curvature of the edges that a portion was missing from the under side of the tail. The conviction was borne in upon us that we saw a portion of the tail blotted out or cut off in some way, and this was certainly not done by cloud. Was it done by the earth's atmosphere? The following morning was cloudy, and nothing was seen at 3.30, but the comet appeared in the western sky at 5.40 in the evening.

Observations were not taken on succeeding mornings, which perhaps was a mistake, as something may have been left behind after contact with the earth, if contact really happened.

W. H. FINLAY.
W. A. DOUGLAS RUDGE.

University College, Bloemfontein.

The Colour of Pure Water.

HAVING noticed the colour of the sky, of air, and of water under different conditions, I was reminded on reading the report of Lord Rayleigh's lecture (NATURE, March 10) of a few notes I had made from time to time, and now think they may prove of interest.

First, optically pure water cannot be obtained by distillation. Prof. Tyndall asked me to prepare some pure water for him, which I attempted, first by distillation with acid permanganate, and then re-distilling this from a copper vessel and collecting the liquid in a bottle placed in a large bell-jar of hydrogen, a gas which is known to provide an optically pure atmosphere. The resulting water was not optically pure. Pure water was prepared by Tyndall by melting clear block-ice in a vacuum. Its colour was blue when seen through a tube 3 feet long.

The colour of a hard water which has been softened by Clark's process may be seen at the Colne Valley waterworks, visible from the train on the up line just south of Watford Station, and at Joynson's paper works at St. Mary Cray, in Kent. When the members of the Society of Chemical Industry visited these works some years ago, they were much struck by the very beautiful blue of the water. It was even suggested that it had been purposely coloured with a very pure blue dye. Water of similar purity, containing very little mineral matter, being remarkable for its softness, comes from the Greensand below the London Clay. Such blue water I have noticed

in the bed-rooms and bath-rooms of the Euston Hotel, the supply coming from an artesian well.

There are two natural sources of extremely pure water with which I am acquainted, and I cannot believe that the water from the second source receives any colour or appearance of blue through the reflection of light by fine particles in suspension. The first is in the Fairy Loch beside Loch Lomond, situated on a little promontory south of Tarbert. It is difficult to see that there is any colour in the water except at a point where it wells up from a fissure in the rock and passes over a vein of milk-white quartzite which crosses the bottom; here it exhibits a beautiful blue colour.

The second source is the Wells of Dee, situated in the Larig (Learg Gruamach) at the foot of Ben Macdhui, and between it and Braeriach, about half-way between Deeside and Speyside. It is a small tarn or pool with a bottom like that of three miles of the pass—nothing but large pieces of splintered red granitic rock. It stands about 2700 feet above the sea. The water, according to my recollection, passes down underneath broken rocks in a narrow rift in the mountain side, and is derived from the melting of snow on its northern slope near the summit, which is 1598 feet (1500 feet by my aneroid) higher and above all vegetation. The pool is too small to be shown, but the stream which runs out of it appears on the Ordnance map (Sheet 64, 1-inch scale), springing from the highest point of the pass. Some small lochs on the opposite side of the pass, about $1\frac{1}{4}$ miles further south, are also called Wells of Dee, and are the principal source of the river of that name. The bottom of the small pool is visible everywhere, and its apparent colour varies in proportion to its depth, being dull red near the sides, to a brownish-purple where it is apparently deepest. The pure blue colour of the water was only seen on putting a white object, such as a piece of porcelain, into it. The effect of the blue colour of the water on the light reflected from the red rock at the bottom is to give it a purple tint.

It is evident that the blue is wholly due to the absorption of rays of complementary colour, because if it were not the reflection of blue rays by suspended fine particles would be seen against a dark ground on looking into the water. As a matter of fact, the water when undisturbed on the surface was not visible; it was very difficult to form any idea of its depth, everything on the bottom being sharply defined. These observations were made under a diffused and subdued light in a very clear atmosphere, the light being of uniform intensity over the whole sky, which was entirely covered with small greyish clouds, no direct sunlight or blue sky being anywhere visible. A fact adverse to the view that the blue could be reflected light is that the light which escapes reflection has a reddish-golden colour. In a hazy atmosphere when the sun is low and we look towards it, we see the golden colour; in the opposite direction we see the blue opalescence. The white light from the sky traversed the water in two directions to the bottom, and then, by reflection, back again, and it is safe to say that these two opposite colours would neutralise each other. W. N. Hartley.

Royal College of Science, Dublin.

The Temperature Conditions in Clouds.

As one of those who expressed doubt as to the possibility of the existence of the temperature conditions in a cloud described by Prof. Rotch at Winnipeg, I have been greatly interested by the letters of Dr. Aitken and Mr. Palmer (Nature, November 18, 1909; June 2, 1910), but the examples which they quote do not present the same difficulty as Rotch's result, nor do they explain it.

The increase of temperature at or above the *upper* surface of clouds, which Dr. Aitken mentions, has been frequently observed in kite ascents at various places, while the two examples given by Palmer are (1) alto-cumulus, a wave cloud of the Helmholtz type formed at a surface of discontinuity: the temperature decreases upwards in the cloud itself; (2) alto-stratus, a shallow cloud formed also at a surface of discontinuity; here, too, the temperature decreases upwards in the actual cloud. In neither case do we attribute the temperature peculiarity to the clouds, but regard the clouds rather as the result of the temperature conditions.

Rotch, however, found that in a cumulus cloud, 2 km. thick, the temperature increased from the *base* upwards by more than 5° C., and the increase was most rapid in the *lower* part of the cloud.

Dr. Aitken suggests that the sun, shining on the upper part of a cloud already formed and warming it, would account for the phenomenon, or at least for inversions near the upper surface of a cloud; but if the sun raised the temperature of the upper part of the cloud, that part would be no longer in equilibrium with its surroundings, and would rise upwards. Its temperature would, in consequence, fall under ordinary conditions until equilibrium with the surrounding atmosphere again supervened. The sunshine could only result in an actual increase of *temperature* if there existed already above the cloud an atmospheric layer of higher temperature than that in the cloud itself.

Now if Rotch's cloud were formed by convection currents according to the generally accepted ideas, the summit would be initially at least 10° C. colder than the base, and consequently its temperature must have been raised 15° C. to bring about the observed state of affairs. It is not easy to imagine how this could be done without dissipating the cloud, because it is unlikely that a cloud 2 km. high would be formed by convection currents without the upper parts losing some of the water-vapour which they originally contained, and in the present instance evaporation would begin before the temperature had risen 10° C. Moreover, the ascent took place about 9 a.m. in May; while assuming that 35 per cent. of the incident sunshine is absorbed by the cloud (Abbott and Fowle found 65 per cent. reflected) and that no loss of heat by radiation occurred, it would take a twelve-hour day near the equator to raise the mean temperature of a hemispherical cloud 2 km. high by 9° C. It appears certain, therefore, that solar radiation incident on the cloud cannot account for the phenomenon.

The only reasonable explanation I can put forward is that air below and above an inversion surface is lifted bodily upwards sufficiently far for condensation to take place on both sides. The balloon ascent must have been made in a region of convergence, and the mechanism by which the conditions were produced appears to have consisted of a cold, damp easterly wind penetrating beneath a warm upper current from a more southerly point.

Cambridge, June 6. E. Gold.

The Fertilising Influence of Sunlight.

With reference to Dr. Russell's remarks on this subject in Nature of April 28, I should like to remark (1) that my point was not so much that toluene removed toxic material from the soil as that it rendered it insoluble. The question of washing out material from the soil was not raised by me. (2) and (3) Dr. Russell seems to beg the question by taking "fertility" and "bacterial activity" as synonymous. He has not, so far as I can find, proved that the addition to partially sterilised soil of an aqueous extract—or of a portion—of an untreated soil increases *crop production* (in contradistinction to soil fertility as indicated by bacterial activity and ammonia-production). If such is found to be the case, it would certainly require further experiment before it could be explained on the toxic theory.

With regard to water cultures, in one experiment the water was boiled every two days in some of the cultures, while in others it was not boiled. At the termination of the experiment—two days after the last boiling—the bacterial contents were found to be (per c.c.):—

In unboiled cultures ... ... $\left\{\begin{matrix}2500\\2100\end{matrix}\right\}$ Mean = 2300

In boiled cultures ... ... $\left\{\begin{matrix}350\\400\end{matrix}\right\}$ Mean = 375

The quantity of material precipitated by potassium sulphate from the two solutions was (per million):—

Unboiled solution	30
Boiled solution	30

It would appear that if this substance had been produced by the bacteria there ought to have been *at least* seven times as much produced in the unboiled as in the boiled solution, since the bacterial content of the latter was never more than one-seventh of the former, and must have been for most of the time almost *nil*.

I have now completed an experiment in which the following results (among others) were obtained with the "great millet" (Sorghum), single plants of which were grown from germinated seeds for ten days in soil (1) unheated; (2) heated to 97°; and (3) heated to 170°:—

Treatment of soil	Green weight of plants (in grams)	
Unheated ...	145·5 ...	Mean of 8; max. 314, min. 0
Heated to 97°	151·7 ...	" " 353, " 36
" 170°	1055·6 ...	" " 1470, " 835

At 170° the soil was obviously sterilised completely, but the yield was four times that from the partially sterilised soil. F. FLETCHER.

School of Agriculture, Giza, May 14.

POT experiments are carried out by Dr. Hutchinson and myself to run parallel with the chemical and bacteriological examinations of the soils. Productivity is not regarded as synonymous with bacterial activity, although in general the two are intimately related. An exception occurs when the soil has been heated sufficiently to decompose some of the organic matter present with formation of plant food. As stated in my letter, the addition to toluened soil of an aqueous extract of untreated soil increases crop productiveness. E. J. RUSSELL.

Rothamsted Experiment Station, Harpenden.

Ooze and Irrigation.

THE interest which my former letter has aroused (NATURE, June 9) induces me to offer a few further remarks. For a hundred years it was usually thought that all our earthworms were of one kind, and the term *Lumbricus terrestris* was glibly used. Thanks to the help I have received from curators, gardeners, and nature-lovers at Kew, Chelsea, Oxford, Cambridge, Edinburgh, and elsewhere, my list of British Lumbrici now stands at nearly forty species, belonging to upwards of half-a-dozen genera.

In like manner, nearly all fresh-water worms have, until recent times, been relegated to one species, and *Tubifex rivulorum* was the magic name. Our knowledge of these wonderful ooze-workers is still deplorably limited, but a little progress is being made in their study. We now know that the so-called Tubifex is not a tube-maker, and that it includes such genera as Limnodrilus, Stylodrilus, Trichodrilus, and others, which represent more than one family, with upwards of twenty known British species. Every year is bringing new forms to light, and each new discovery supplies a missing link.

But, in addition to the ooze-makers belonging to the Tubifex group, I now find that certain species of white worms, which are destitute of red blood, and are usually grouped together as Enchytræids, frequently find employment in this capacity, and often get introduced among valuable plants in garden and field, to the great loss of the horticulturist. Hence the need of a fuller and more systematic study of this branch of science. Here is a subject worthy of Earl Carrington's new committee.

One correspondent remarks that the subject is "very suggestive." He adds a query which needs attention. "I suppose the worms cannot take nitrogen directly from the air like the legumes? If they could assimilate it, of course a very important point would be settled by establishing that fact, though the probabilities are that they cannot." I should like to know what biologists have to say.

Great Malvern. HILDERIC FRIEND.

New Development in Library Work.

WITH the permission of the council of this society, I have recently instituted a departure in library practice, which I have been asked to describe to you, in the belief that other learned societies may think it worth while to try the experiment.

Fellows of medical and other scientific societies living abroad suffer many disadvantages as compared with their resident brethren, and none so great or so much felt as the deprivation of the use of their libraries. To all our fellows living abroad we now offer to prepare for them, *gratis*, short abstracts of papers, and even of books, upon any medical subject, and to search for or check references to medical literature.

The innovation has been most warmly welcomed, and from remote parts of the world we have received many grateful letters. Men living in the Chitral Valley, in the Sudan, in Christmas Island, and equatorial Africa, who for years have had their work hindered by lack of library conveniences, say that what we now do for them is even better than they could have done for themselves had they been in London, for even here they would probably not be able to devote the many hours requisite for the research required to produce the results which our machinery can procure for them with a minimum of time and labour.

J. Y. W. MACALISTER.
(*Secretary*.)

The Royal Society of Medicine, 15 Cavendish Square, W., June 16.

Altruism in Animal Life.

YOUR Deal correspondent, Mr. Christopher Morse, has told you (p. 437) of an ablutionary caterpillar; let me tell you of life-saving "eels" in vinegar. I was examining the creatures with a microscope when one of them became stranded, owing to its having strayed into the shallower portion of the vinegar-drop, and there it wriggled the while the fluid grew shallower still. Just as it seemed on the point of giving its last expiring wriggle, what was my amazement to see three or four other "eels" make a dash from the deeper vinegar, and force themselves across the shallow to where lay their stranded comrade.

Then occurred the most singular thing it has ever been my lot to witness in the world of minute life. These tiny life-savers rushed with all the energy of desperation at their now quiescent comrade, and worked it slowly towards the deeper part of the fluid, and they reached it, too, in time to save their own and the other's life. J. H. ELGIE.

72 Grange Avenue, Leeds.

Colours of Plasmodia of some Mycetozoa.

FROM my experience in this part, I here note the colours of plasmodia of a few Mycetozoa to supply the desiderata in the late Mr. Lister's "Monograph," London, 1894:—

Physarum melleum, Mass.	Yellow, then orange-yellow
P. tenerum, Rex.	Bright primrose-yellow
P. crateriforme, Petch, *in litt.* (Ceylon and Japan)	Dull ochreous
P. gyrosum, Rost.	Dingy ochrey-yellow, then dirty pink
Arcyria insignis, Kalchbr. and Cke.	Colourless, then milky-white
Perichaena variabilis, Rost.	Watery cinnamon

The following species have their plasmodia mostly of the colours as recorded by Mr. Lister, but at times of the subjoined colours:—

	Normally coloured	Occasionally coloured
Physarum cinereum, Pers.	Watery-white	Pale yellow
Stemonitis splendens, Rost., B. *Webberi*.	Creamy-white	Sulphur-yellow
Lycogala miniatum, Pers.	Rose-red	Bright yolk-yellow or milky-white

As regards the last-named species, Miss Gulielma Lister writes to me:—"Since my father's 'Monograph' was written we have several times had instances of the æthalia arising from a white or cream-coloured plasmodium."

Now a few words on the number of species of the Japanese Mycetozoa. In the *Journal of Botany*, April, 1904, pp. 97–9, Mr. and Miss Lister noticed eighteen species collected by Mr. S. Kusano in Tokio, eleven of which had been enumerated in Prof. Matsumura's "Index Plantarum Japonicarum," published a few months previously in the same year. Since my return home from England in 1900, in order to keep my promise to Mr. George Murray, then keeper of the Botanical Department, Natural History Museum, I have sent for determination to Mr. and Miss Lister every characteristic specimen I could find in this province, which has resulted in the Japanese species of Mycetozoa actually reaching a total number of eighty-six, including the two new species *Arcyria glauca*, Lister, and *Hemitrichia minor*, G. Lister, not to mention several new varieties and forms.

KUMAGUSU MINAKATA.

Tanabe, Kii, Japan, May 21.

KOREAN GEOLOGY.[1]

BEFORE the year 1883, when treaties were made by which Europeans were admitted to the country, Korea was a *terra incognita* to geologists. Captain Basil Hall had, indeed, made a few observations upon rocks examined by him on the coast during his voyage in 1818, and casual references may be found in other authors concerning what could be seen from the sea. In 1883 and 1884, however, a German geologist, Dr. Gottsche, made a rapid geological reconnaissance of the country, and the rock specimens he obtained were described by Prof. Justus Roth. Almost simultaneously with Dr. Gottsche, Prof. Gowland, then head of Imperial Mint of Japan, made a journey through the country for the purpose of archæological investigation, and the numerous specimens which he collected were described by Mr. (now Sir Thomas) Holland in the Geological Society's Journal for 1891. In the accounts of his explorations in China (1900–3), the late Baron F. von Richthofen was able to give additional particulars concerning the geological structure of the country. Dr. Bundjirô Kotô, the author of the work before us, published his account of the orography of the peninsula in 1903, a memoir which has given rise to a considerable amount of controversy.

FIG. 1.—Whirlpool of Myōng-yang ferry showing special topography with narrows and indentations which probably cause the eddy produced in the shore current by the reflex motion.

As the result of the Russo-Japanese war, however, the country has been much more fully opened up, and the Japanese Government has sent out a number of expeditions for the purpose of inquiring into the natural resources of the country. Unfortunately, most of the reports of these explorations are written in Japanese, but Dr. Kotô has rendered a great service to geologists by embodying the most important results of these recent researches in his memoir.

[1] "Journeys through Korea." By Prof. B. Kotô. From the Journal of the College of Science, Tokyo, Japan, vol. xxvi. Pp. 207+36 plates. (Tokyo: The University, 1909.)

The work deals mainly with the southern part of the peninsula, and describes three traverses made by the author; the important discoveries made by Mr. Yabé of fossil plants and foraminifera have been of great service in determining the geological age of some of the rock-masses.

Overlying a great mass of gneiss, mica-schist, and phyllite rocks, which may be Archæan in age, though Dr. Kotô inclines to the view that they are metamorphosed Mesozoic deposits, there are great masses of granitic rocks, including some very interesting types. Above these granites are found a series of strata, which are shown by the plants they contain to be of Jurassic age. With these deposits are found evidences of contemporaneous volcanic action, while quartz-veins with gold also occur in them. In Japan these Jurassic strata appear to be underlain by Fusulina limestones of Carboniferous age, and anthracite beds containing Rhætic plants. Rocks of this age appear to occur in other parts of the peninsula, but not in the district examined by Dr. Kotô.

Of younger age than the Jurassic appear to be the series of eruptive rocks which our author classes as "Neogranites." These consist of quartz-porphyry (quartz-tsingtauite) and orthoclase-porphyry (tsingtauite), with a variety of granite-porphyry for which the author proposes the term "Masanite"—the name being derived from the port of Ma-san-pho—and an aplite-granite ("Granomasanite"). Dr. Kotô regards his masanite as worthy of receiving a distinct name, from the peculiar mode of the intergrowth of quartz and plagioclase felspar of which it is mainly composed. These plutonic rocks pass into a series of effusives classed by the author as different types of "felsophyres."

FIG. 2.—Remarkable erosion-form, viewed from the south. It is a double-peak, formed of Mesozoic conglomerate resting upon a gneiss-granite.

Lying unconformably upon the greatly disturbed Mesozoic strata, are found sandy strata with seams of poor lignite, while more recent deposits are only

represented by lava sheets of basalt and hornblende-andesite.

The author indicates many points in the geology of Korea on which conflicting opinions have been maintained by different authors, and it is evident that much work remains to be done in the country before some of these problems can be regarded as settled. But, in the meanwhile, this work may be accepted as giving a first sketch, clear and accurate, of what is known on the subject, with full references to the works of other authors.

The plates accompanying this memoir are by no means the least valuable part of the production. From Dr. Kotô's own photographs a hundred small but admirably executed views of Korean scenery have been prepared, two of which are here reproduced.

J. W. J.

IN THE TORRID SUDAN.[1]

ONE feature about this and all other recent books dealing with the Egyptian Sudan which arrests the attention is the singular lack of picturesque scenery characteristic of this vast region away from the frontiers of Abyssinia or the temples and rocks of Dongola. Apparently one has to reach almost to the verge of the Congo Basin on the south-west, or to enter the Uganda Protectorate on the south, before the eye is gratified by remarkable landscapes. Even the river-courses outside desert influence are poor and unimpressive in their vegetation as compared with Equatorial, West, and South Central Africa. The branching dūm palms, with their half-circle fronds, an occasional monstrous baobab or banyan-like fig-tree—perchance a clump of tall acacias in the gracious aspect of the rainy season—alone relieve the monotony of grassy plain and stony, sun-smitten wastes; while, of course, a considerable portion of the area of the Anglo-Egyptian Sudan is swamp, and swamp which is singularly unprepossessing, for it offers an unbroken horizon of dull bluish-green, unmarked by a single palm-tree or other noteworthy object.

FIG. 1.—Nuer Paddling Canoe From "In the Torrid Sudan."

The swamps of Central and Western Africa provide some of the most striking pictures to be obtained by the painter or the photographer in all Africa; immense Raphia palms, tall and exquisitely beautiful Phœnix palms, and gigantic trees two hundred feet in height rise above the stagnant water and the masses of papyrus, arums, terrestrial orchids, and amarantaceous plants. Mr. Tangye is conscious himself of the lack of picturesqueness in the Eastern Sudan (as compared with other parts of Africa). "The country, as a rule, is either too dry during a great portion of the year, or, farther south in the great swampy regions, too wet. It is annually devastated by destructive grass fires, which scorch and stunt the trees, leaving the deep-seated grass-roots unharmed and manured by the salts of the burnt ash." The trees are "small, straggly specimens" of acacias for the most part, with a few Borassus and Hyphæne palms.

As to these palms, it is interesting to learn that the elephants apparently feed on the fruit of the Borassus (afterwards ejecting its stone). This fact was mentioned by the writer of this review some years ago, but was denied by other "Africans," who alleged that it was only on Hyphæne fruits that the elephant regaled himself.

The author has some interesting remarks to make on pp. 56 and 57 as to the "painted forests" of acacia, the appearance being due to the irregular peeling of the bark, together with the exudations of red gum. In these acacia woods the guinea-fowl are present in thousands.

There are interesting notes on the baboons (p. 78) and on the giraffe (pp. 79–80). The manners and customs of elephants are well described, together with their apparent, if often misplaced, sense of humour (they will pass through native villages demolishing the huts, but refraining from injuring the people; they will also come and stamp out native gardens, or in attacking native caravans will merely scatter their luggage right and left).

There is a good deal of information about the Nilotic negroes, much of which is original. The author mentions that an average of height taken by the late Dr. Pirrie gave 5 ft. 11 in. for the men, while heights of more than 6 ft. were quite common. He also directs attention to certain points of similarity between the Nilotic negroes and the Melanesians which are not unworthy of notice, considering that they are here and there backed up by evidence of physiological affinity, though, of course, the gap between these two manifestations of the negro type is enormous both in millenniums and miles. Quite recently Dr. A. Keith has pointed out the craniological affinities between certain tribes of the Congo Basin and the Andamanese. The present writer has noted also certain similarities in weapons and body adornments between the Australoids and the people living on the north-eastern verge of the Congo Basin.

The awful ravages of the bush-fires in the Sudan have been already alluded to. This, no doubt, is the principal cause of ancient and modern deforestation, which has done so much to affect the surface and climate of this part of Africa.

A determined effort out of somewhat needless concern for the feelings of the French (who had nothing to be ashamed about over Marchand's marvellous

[1] "In the Torrid Sudan." By H. Lincoln Tangye. Pp. xii + 300. (London: J. Murray, 1910.) Price 12s. net.

journey) is being made by the Anglo-Egyptian authorities to erase the name of Fashoda from the map and to call it instead Kodok. But the earlier and more picturesque name seems likely to survive, and the place itself (according to the author) is distinctly going ahead in spite of its evil reputation for malaria. On p. 286 the author gives an interesting account of a tame lion belonging apparently to a British officer resident in Omdurman at one time. When a small cub he had been soundly thumped by his master's fist to reduce him to order. As he grew into a large beast he remained mortally afraid of a thump, though its actual meaning to him then was nothing. He was perfectly good-humoured and kindly, but too playful, and delighted in jumping out on people in order to startle them, or leaping on to them in order to bear them to the ground. He would also climb the telegraph-poles (for, despite current belief to the contrary, lions are able to climb, as the present writer can bear witness). On one such occasion, from the top of the pole on which he was resting his chin to get a good look out, he descried his master coming from a distance, and, fearful of punishment, slid down the pole on to the ground with a bump which sobered him for days.

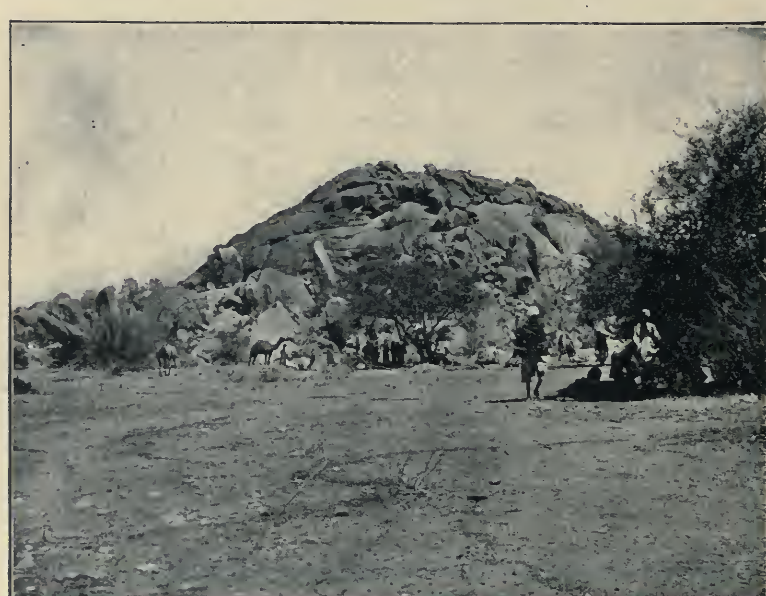


FIG. 2.—Gebel Kordi: a typical Hill 350 feet high. From "In the Torrid Sudan."

This book is not an easy one to review, for its information is put together in a scattered and unpretentious form, but it is very readable, and gives one as a reward for its perusal a remarkably vivid picture of the general aspect and conditions of the Sudan between Khartum and the Bahr al Zeraf, the White Nile, the Blue Nile, and the river Dinder.

H. H. JOHNSTON.

PWDRE SER.

IN my boyhood I often lived on the coast of Pembrokeshire. Wandering about with my gun I was familiar with most natural objects which occurred there. One, however, which I often came across there, and have seen elsewhere since, greatly roused my curiosity, but I have not yet met with a satisfactory explanation of it.

On the short, close grass of the hilly ground, I frequently saw a mass of white, translucent jelly lying on the turf, as if it had been dropped there. These masses were about as large as a man's fist. It was very like a mass of frog's spawn without the eggs in it. I thought it might have been the gelatinous portion of the food disgorged by the great fish-eating birds, of which there were plenty about, as kingfishers eject pellets made up of the bones of the fish they eat, or that possibly there might be some pathological explanation connecting it with the sheep, large flocks of which grazed the short herbage. But the shepherds and owners of the sheep would have known if such an explanation were admissible. They called it "pwdre ser," the rot of the stars.

Years afterwards I was in Westmorland, on the Geological Survey, and again not unfrequently saw the "pwdre ser." But I now got an addition to my story. Isaac Hindson, of Kirkby Lonsdale, a man whose scientific knowledge and genial personality made him a welcome companion to those who had to carry on geological research in his district, told me that he had once seen a luminous body fall, and, on going up to the place, found only a mass of white jelly. He did not say that it was luminous. I have never seen it luminous, but that may be because when it was light enough to see the lump of jelly, it would probably be too light to detect luminosity in it.

Then, in my novel reading, I found that the same thing was known in Scotland, and the same origin assigned to it, for Walter Scott, in "The Talisman,"[1] puts these words in the mouth of the hermit:—"Seek a fallen star and thou shalt only light on some foul jelly, which in shooting through the horizon, has assumed for a moment an appearance of splendour." I think that I remember seeing it used elsewhere as an illustration of disappointed hopes, which were "as when a man seeing a meteor fall, runs up and finds but a mass of putrid jelly," but I have lost the reference to this passage.

Thus it appeared that in Wales, in the Lake District, and in Scotland, there existed a belief that something which fell from the sky as a luminous body lay on the ground as a lump of white jelly.

I asked Huxley what it could be, and he said that the only thing like it that he knew was a nostoc. I turned to Sachs[2] for the description of a nostoc, and found that it "consists, when mature, of a large number of moniliform threads interwoven among one another and imbedded in a glutinous jelly, and thus united into colonies of a specifically defined form. . . . The gelatinous envelope of the new filament is developed, and the originally microscopic substance attains or even exceeds the size of a walnut by continuous increase of the jelly and divisions of the cells."

All the nostocs, however, that I have had pointed out to me have been of a green or purplish or brown-green colour, whereas the "pwdre ser" was always white, translucent in the upper part, and transparent

1 "Waverley Novels," Border edition, chapter xviii., p. 278.
2 Sachs, "Text-book of Botany, Morphological and Physiological." Translated and annotated by Alfred W. Bennett and W. T. Thiselton-Dyer. (1875.)

in the lower part, which appeared to occur among the roots of the grass, as if it grew there. Moreover, the mass was much larger than a walnut, in fact, would generally about fill a half-pint mug.

The only reference I can find from which it would appear that the writer was describing a nostoc is the passage in Dryden and Lee[1] (1678).

"The shooting stars end all in purple jellies." In the following note, appended to this passage, it is clear that the writer thought that the jelly-like matter found where shooting-stars had seemed to fall, was white.

Note.—"It is a common idea that falling stars, as they are called, are converted into a sort of jelly. Among the rest, I had often the opportunity to see the seeming shooting of the stars from place to place, and sometimes they appeared as if falling to the ground, where I once or twice found a white jelly-like matter among the grass, which I imagined to be distilled from them; and thence foolishly conjectured that the stars themselves must certainly consist of a like substance."

Poets and divines carry the record of this curious belief far back into the seventeenth century.

Suckling[2] (1541) says:—

> "As he whose quicker eye doth trace
> A false star shot to a mark't place
> Do's run apace,
> And, thinking it to catch,
> A jelly up do snatch."

Jeremy Taylor[3] (1649):—

> "It is weaknesse of the organ that makes us hold our hand between the sun and us, and yet stand staring upon a meteor or an inflamed gelly."

Henry More[4] (1656):—

> "That the Starres eat . . . that those falling Starres, as some call them, which are found on the earth in the form of a trembling gelly, are their excrement."

Dryden[5] (1679):—

> "When I had taken up what I supposed a fallen star I found I had been cozened with a jelly."

William Somerville[6] (1740):—

> "Swift as the Shooting Star that gilds the night
> With rapid transient Blaze, she runs, she flies;
> Sudden she stops nor longer can endure
> The painful course, but drooping sinks away,
> And like that falling Meteor, there she lyes
> A jelly cold on earth."

Several old writers, however, while agreeing as to the mode of occurrence of the "pwdre ser," and recognising the widespread belief that it was something which fell from the sky and was somehow connected with falling stars, have tried to find some more commonplace and probable explanation of the phenomenon, and most of them refer it to the stuff disgorged by birds that had fed on frogs or worms.

Merrett[7] (1667), for instance, in his work on meteors and wandering lights, says:—

> "Sequuntur Meteora, ignita, viz. Ignis fatuus, the Walking fire, or Jack of the Lantern, Castor and Pollux, Helena, Ignis lambens. Draco, Stella cadens: Est substantia quaedam alba et glutinosa plurimis in locis conspicua quam nostrates 'Star-faln' nuncupant, creduntq; multi originem suam debere stellae cadenti hujusq; materiam esse. Sed Regiae Societati palam ostendi solummodo oriri ex intestinis ranarum a corvis in unum locum congestis, quod aliis etiam ejusdem societatis viri praestantissimi postea confirmarunt."

[1] "Œdipus," ii., 1, a tragedy in 5 acts in verse, with notes, &c., by Sir Walter Scott, revised and corrected by George Saintsbury. Vol. vi., p. 159.
[2] "Poems Farewell to Love." Fragmenta Aurea; a collection of all the incomparable pieces written by Sir I. Suckling, p. 45. (London, 1546.)
[3] "The Great Exemplar of Sanctity, &c." Preliminary Exhortation, par. 7, p. 5.
[4] "Enthusiasmus Triumphatus," p. 45; D.N.B., vol. xxxviii., p. 422a.
[5] "The Spanish Friar." Dedication, p. 404.
[6] "Hobbinol, or the Rural Games": a Burlesque Poem in Blank Verse, 3rd edition, p. 70.
[7] Merrett, "Christophorus, Pinax: Rerum naturalium Britannicarum, continens vegetabilia, Animalia, e. Fossilia in hac Insula reperta inchoatus," ed. 2der Lond., 1667, p. 219.

The Rev. John Morton,[1] of Emmanuel College (1712), is, however, the only one who, so far as I can ascertain, ever tried any experiments with the view of finding out what it really was. He set some of it on the fire, and when he had driven off all the watery part, there was left a film like isinglass, and something like the skins and vessels of animal bodies. He records many observations as to its time and mode of occurrence; for instance, he says that "in 1699–1700 there was no star-gelly to be found about Oxenden till a wet week in the end of February, when the shepherds brought me above thirty several lumps." This and other observations suggest that it is a growth dependent upon the weather, &c. On the other hand, he says that he saw a wounded gull disgorge a heap of half-digested earth-worms much resembling star-jelly, and that Sir William Craven saw a bittern do the same in similar circumstances.

The Hon. Robert Boyle,[2] 1744, explaining how clammy and viscous bodies, such as white of egg, are reduced to a thin and fluid substance, says:—

> "And I remember, I have seen a good quantity of that jelly, that is sometimes found on the ground, and by the vulgar called a star-shoot, as if it remained upon the extinction of a falling star, which being brought to an eminent physician of my acquaintance, he lightly digested it in a well-stopt glass for a long time, and by that alone resolved it into a permanent liquor, which he extols as a specifick to be outwardly applied against Wens."

Pennant[3] seems to have supposed that its origin was that suggested by Morton, for in his description of the winter mew he says:—"This kind (*i.e.* the Coddy Moddy or Winter Mew) frequents, during winter, the moist meadows in the inland parts of England remote from the Sea. The gelatinous substance, known by the name of star shot, or star gelly, owes its origin to this bird or some of the kind, being nothing but the half digested remains of earth-worms, on which these birds feed and often discharge from their stomachs."

I have found it commonly near the sea, but have never seen any trace of earth-worms or other similar food in it.

Here, then, we have a well-known substance which may be of different origin in different cases, respecting the general appearance of which, however, almost all accounts agree. The variety of names under which it is known point to its common and widespread occurrence, *e.g.* pwdre ser, star-slough, star shoot, star shot, star-gelly or jelly, star-fall'n.

We have in every name, and in every notice in literature, a recognition of the universal belief that it has something to do with meteors, yet there does not appear to be any evidence that anybody ever saw any luminosity in the jelly. Nor has anybody seen it disgorged by birds, except in the case of those two wounded birds where some half-digested gelatinous mass was thrown up. Nor has anyone watched its growth like nostoc from the ground.

In 1908 I was with my wife and one of my boys on Ingleborough, where we found the "pwdre ser" lying on the short grass, close to the stream a little way above Gaping Ghyl Hole. For the first time I felt grateful to the inconsiderate tourist who left

[1] "The Natural History of Northamptonshire, with some Account of the Antiquities, &c." By John Morton, M.A., F.R.S., Emanuel College, Cambridge, Rector of Oxenden. (London, 1712, p. 352.)
[2] "The Works of the Hon. Robert Boyle," in 5 vols. Vol. i., p. 244, of Fluidity, Sect. xi. (London, Millar.)
[3] "Zoology Folio," 1766, p. 142.

broken bottles about, for I was able to pack the jelly in the bottom of one, tie a cover on, and carry it down from the fell. I sent it, with the sod on which it appeared to have grown, to my colleague, Mr. E. A. Newell Arber, with a brief sketch of my story and the reason why I thought it of interest. Mr. Arber reported that it was no nostoc, and said that he had sent it over to Mr. Brookes, in the Botany School, who reported that it was a mass of bacteria.

That is the end of my story, but I confess I am not satisfied. The jelly seemed to me to grow out from among the roots of the grass, and the part still tangled in the grass was not only translucent but quite transparent.

What is it, and what is the cause of its having a meteoric origin assigned to it? Has anyone ever seen it luminous?

Should anyone come upon it I should be very grateful if they would send it, and the sod on which it is found, to the Botany School at Cambridge, with a label indicating what the parcel contains, so that it may be attended to before decay has perhaps obscured important features.

T. MCKENNY HUGHES.

THE TOTAL SOLAR ECLIPSE OF MAY 9, 1910.

UP to the time of writing (May 28) no account has been received from Mr. F. K. McClean with regard to the erection and adjustments of the various instruments he took out with him for the solar eclipse. It will be remembered that the observing station he chose was near Port Davey, and he selected a small island, called Hixson Point, for the actual site of the camp. The accompanying illustration (Fig. 1) indicates the position of this island in relation to the neighbouring country, and is from a photograph taken towards the east from Morning Hill.

Mr. McClean has, however, sent an intermediate letter, which will, no doubt, be read with considerable interest, describing the first week's operations from the time of the arrival of his entire party by the *Wainui* on April 7, with their whole kit and instruments. This account shows vividly the strenuous life which the party had continually to undergo during the initial stages of their settlement, and in a letter Mr. McClean states that so far "this trip is a triumph of matter over mind, as the latter has not had a look in yet, and never would have if it were not for the muscles of the party."

The accompanying illustrations, from photographs taken by Mr. H. Winkelmann, will serve best to show two specimens of the work which had to be undertaken. The first (Fig. 2) shows the avenue which had to be made from the camp to the instrument site. The figure standing up is Mr. Young, the bending figure Mr. Dowsett. In Fig. 3 is shown the method adopted for carrying the loaded packing-cases from the water's edge to the site; the figures from right to left are Messrs. McClean, Young, Brooks, Dowsett, and the last one, on the extreme left, unknown, probably one of the miners who was in the locality, and who assisted the members of the expedition.

The communication to which reference above has been made was dated April 17, and was dispatched from Port Davey by the steamer *Wainui*. The contents are as follows:—

"On April 5 Mr. Hughes, of the Union S.S. Co., supplied us with a time-table of the *Wainui*, and informed us that the steamer would call in when passing in each direction if weather permitted, but at the absolute discretion of Captain Livingstone.

"News arrived the following day that the 6-inch Cooke O.G. of 30 feet focus would arrive by the *Athenic* on April 14, and arrangements were made for its dispatch to Port Davey.

"A telegram was also received from Mr. J. Short, of Sydney Observatory, in answer to an invitation to set up his instrument alongside of ours, in which he said that he was awaiting Government sanction, and would be glad to join us.

Finally, on April 9, the *Wainui* arrived from Melbourne, and all our instruments, tents, timber, ironmongery, food, drink, clothing, and a whale-boat were put on board,

FIG. 1.—The Country about Hixson Point, the site of the Eclipse Camp.

altogether about 140 cases and packages, and we left Hobart at 9 p.m.

"The following morning we entered Port Davey in a strong south-west wind and a heavy swell, but as soon as we passed the Breaksea Islands the sea became calm, and the landing was effected without trouble. One of the ship's boats took the instruments and cement to the foot of Hixson Point, where they were hauled up the low bluff on planks by block and tackle, and left in a pile covered with a large tarpaulin until they could be carried to the observatory site. Our whale-boat took the camp equipment up the cove to where a small stream ran through a clump of bush, and here we set up our tents after the steamer left. The landing was done between 9.30 a.m. and 2.0 p.m. with the help of some of the officers and crew of the *Wainui* and two miners who were hunting in the neighbourhood. The weather all the time was fine, but rain started in the evening after we had set up three tents, in which we spent the first night.

"The following day we completed the camp and cut a path some 100 yards long through the bush with the help of the two miners, who later continued it on through the 2-foot scrub to the observatory site. We then set up the instrument tent close to the site of the observatory, but

on Thursday, April 14, we had to remove it, as the strength of the wind was so great that even with additional guys the whole thing threatened to collapse, and we cut a rectangular space in the middle of some low bush where there was very fair shelter. Our camp consists of a dining tent 12 feet square, a dark-room tent 6 by 9 feet with red lining, three sleeping tents 9 by 12 feet and two of 8 by 10 feet, situated on both sides of a small stream on a site cut out of the bush, and at the head of a small bay.

Fig. 2.—Cutting a path to reach the Eclipse Camp from the shore.

"Then it was necessary to cut a path from the top of the hill to the instrument cases—some 200 yards of very bad ground—and carry the cases up. This was done mostly by four persons on two timbers 2 inches square, but some of the siderostat parts proved too heavy, and had to be left until they could be unpacked and placed directly in position. Also the case containing the large dark-slide for the spectrograph had to be unpacked *in situ*, and the dark-slide alone required two persons to carry it.

"During the whole of the week there was bad weather, nearly always cloudy—night and day—always wind, and frequently rain, so that the foundations for the siderostat and cœlostat had to be oriented by compass only. All the sand and water for the concrete had to be carried up from the stream by hand—a quarter of a mile uphill—which was a big additional labour, but stone was quarried on the hill. Finally, on the Sunday morning (April 17), the foundation of the siderostat was completed, and all but seven cases were on the top of the hill, and, after the severe physical work of the last seven days, we proposed taking a half-holiday for fishing and washing clothes, or anything that the members of the expedition chose to do. But this was not to be, for on finishing lunch we saw an ominous smoke cloud across the sky, and from the top of the bush found that the scrub was ablaze close to the instrument tent. As we came up the flag-pole collapsed, but by much beating we kept the flames from the tent. Within 6 feet of it Worthington's cases—happily empty—were burning furiously, and the large case for the dark-slide of the spectrograph was a mass of flames, as into it had been put all the straw packing from three other cases.

"Having got the fire under control near the instrument tent, half the party were drafted off to prevent it reaching the camp, and later all but two, who were required to watch the smouldering remains on the top of the hill and the line of fire in the neighbourhood of the cases still at the landing place. In spite, however, of the efforts of these six, the fire reached the bush within 60 yards of camp, and it was only due to the constant wet weather of the previous week that it stopped there, as the trees were so saturated that nothing could burn them. Most of the camp equipment was quickly moved to the shore to be covered with a wet tent-fly, and food was placed in the whale-boat, but happily these precautions were not necessary. A constant inspection was kept of the still smouldering hillside, and at 6.30 a fresh blaze started on the edge of the bush close to the bay. This was temporarily overcome by beating and by buckets of water; but the soil was red-hot, being peat, and only constant attention and lengthy rain can put it out. In addition to this there has been a small peat fire the whole time in the bush within 50 feet of the dining tent, which has been watched, but not considered dangerous until now.

"The result of the fire is that two of Worthington's cases have been burnt and one of mine, and the legs of Worthington's equatorial have been singed. The fire was round more than two sides of the instrument tent, and within 4 feet of it at one point.

"The spectrograph dark-slide had already had one narrow escape, as, soon after it left Watson's workshop, the building was burnt to the ground, and now its case is destroyed by fire the day after it was unpacked. It was a near thing, and as we came up the hill we expected to leave by the *Wainui* the following day without instruments or kit."

Fig. 3.—Carrying the instrument cases from the shore to the camp on the hill.

William J. S. Lockyer.

NOTES.

UPON the recommendation of the National Academy of Sciences of the United States, the trustees of Columbia College, New York, have awarded the Barnard medal for meritorious service to science, for the five-year period ending with the year 1909, to Prof. Ernest Rutherford, F.R.S., Langworthy professor of physics and director of the physical laboratory in the University of Manchester, for meritorious service to science resulting especially from his investigations of the phenomena of radio-active materials. The medal is "of gold, nine-tenths fine, of the bullion value of not less than two hundred dollars." Previous awards of the medal are:—1895, Lord Rayleigh and Sir William Ramsay; 1900, Prof. W. C. von Röntgen; 1905, M. Henri Becquerel.

THE death is announced of Prof. Louis Raffy, who for twenty-six years was on the staff of the University of Paris. Since 1904 Prof. Raffy occupied the chair of analysis and geometry. At the funeral, orations were delivered by Prof. Paul Appell, dean of the faculty of sciences in the University of Paris, and by Prof. Bricard, president of the Paris Mathematical Society.

AN International Hygiene Exhibition is to be held at Dresden from May to October, 1911. The exhibition will include five sections: the scientific, the historical, the popular, sports, and industry. The scientific section will aim to present as completely as possible a picture of the science of hygiene. The general secretary for the scientific department is Dr. Weber, member of the Imperial Board of Health, Berlin.

WE regret to announce the death, at College Place, Camden Town, on June 19, in his one hundredth year, of Mr. E. Gerrard, formerly on the staff of the British Museum, and founder of the well-known firm of taxidermists in College Place, Camden Town. Mr. Gerrard, who was born on October 20, 1810, joined the British Museum as special attendant to Dr. J. E. Gray in 1841, and for many years had charge of the osteological collections. He was the author of the "Catalogue of the Bones of Mammalia in the British Museum," published in 1862. After fifty years' service in the museum Mr. Gerrard retired in 1896.

LORD CREWE, Secretary of State for the Colonies, has appointed a committee, formed of representatives of the Colonial Office and of the Natural History Branch of the British Museum, to consider the protection of plumage-birds. The main object in view is to consider to what extent it may be practicable to prevent, either by legislation or by departmental control, the indiscriminate slaughter of such birds now prevalent in certain parts of the Empire. Action of this nature can be effectual only by the cooperation of the Governments of all the countries included in the British Empire, and it is hoped that this may be obtained. The names of the committee will be published in due course. A provisional meeting of the members has been held already.

THE ninety-third annual meeting of the Swiss Society of Natural Sciences is to be held this year at Bâle on September 4–7. During the meeting lectures will be delivered by Prof. W. Ostwald, of Leipzig; Prof. E. von Drygalski, of Munich; Prof. P. Guye, of Geneva; Dr. L. Rollier, of Zürich; Prof. A. Ernst, of Zürich; Dr. Paul Sarasin, of Bâle; and Dr. H. G. Stehlin, of Bâle. The Swiss Societies of Botany, Chemistry, Geology, Physics, Zoology, and Mathematics will meet at Bâle at the same time. The secretary for the meeting is Dr. H. G. Stehlin, Museum of Natural History, Augustinergasse, Bâle, from whom all information may be obtained.

ON Monday last, June 20, at the invitation of the Lord Mayor of Birmingham, a meeting of the most prominent naturalists of the city was held in the Council House to consider the establishment of a Natural History Museum. The Lord Mayor, in opening the meeting, stated that the City Council is willing to allot considerable space for a natural history museum, but cannot undertake to provide the collections. Sir Oliver Lodge moved "that this meeting heartily approves of the establishment of a natural history museum worthy of the city." In the course of an interesting speech he remarked that the study of natural history is of special value to town citizens, and it has become more difficult to carry on the study save by such means as the meeting had assembled to promote. Birmingham is a great city, and can well afford a natural history as well as an art museum. Sir George H. Kenrick seconded the motion. He emphasised the responsibility that rests on individual effort to make the museum a success. He laid particular stress on the value of a library attached to the museum, and well stocked with books dealing with the subjects illustrated only perhaps partially in the galleries. Alderman Beale, chairman of the Art Gallery Committee, and other speakers, including Prof. Carlier, strongly advocated the formation of a museum. If the City Council carries out its intention of allotting the space, there will apparently be no difficulty in filling it, to the great advantage of all branches of the community. An influential committee was formed, and the motion was carried unanimously.

THE council of the Association des Ingénieurs électriciens sortis de l'Institut électrotechnique Montefiore, Liége, has issued the conditions which will govern the triennial award of the prize—the "Fondation George Montefiore"—which is to be awarded for the first time in 1911. The prize will be the accumulated interest on 150,000 francs in Belgian three per cent. funds, and is to be given for the best original work in French or English on the scientific advance and the progress in the technical applications of electricity. The last date for the reception of works to be submitted to the committee of award is March 31, 1911. Competitors should address M. le Secrétaire-archiviste de la Fondation George Montefiore, à l'Hôtel de l'Association, rue St. Gilles, 31, Liége.

THE annual report, dated May 13, of the Society for the Astronomical Study of Ancient Stone Monuments, Cornwall Branch, shows increasing interest in the work undertaken. The "most important excursion the society has ever had" was made on July 16, 1909, to the Wendron Circles. The leading object kept in mind is to follow up some preliminary observations of monuments with a more detailed examination, with the sure result of discovering features which at the first visit escaped attention. A striking feature of the kind is reported from Tregaseal and Wendron. The summer meeting this year was held at Boskednan Circle, Madron, on June 17. The treasurer's report shows an increasing balance in hand. The president is the Right Hon. Viscount Falmouth, and the honorary secretaries Mr. Henry Thomas and Mr. H. Bolitho.

A CORRESPONDENT, after hiving a swarm, noticed certain bees standing on the ledge before the entrance, rapidly moving their wings. It may be observed that when many

bees behave in this way they act as a lure to those outside the hive, and that each bee elevates the tip of her abdomen, and exposes a membrane there, situated between the fifth and the sixth dorsal segments. This membrane gives off a pungent scent, which the waving of the wings disseminates; no doubt the scent attracts bees that have lost their way to the entrance. A bee that has had a difficulty in finding the entrance, before she passes into the hive, stands for a short while on the alighting board to fan and expose her scent membrane. Thus, when many bees are uncertain about the position of the entrance, they are attracted there by the scent. A description of this scent-producing organ of the worker honey-bee, and the vibration of the wings to which our correspondent refers, will be found in Mr. F. W. L. Sladen's "Queen-Rearing in England," published at the office of the *British Bee Journal*, 23 Bedford Street, Strand, W.C.

A national committee (of which the King, when Prince of Wales, acted as honorary chairman), representative of the colonies, of the Navy, of the shipping industry, and of the learned societies, has been formed under the auspices of the British Empire League to secure the erection in London of a memorial to Captain Cook. It is a reproach to the nation that no recognition should have been paid to the memory of a man whose intrepid explorations resulted in such notable additions to the British Dominions, and whose scientific work has been of the greatest value to mankind. For the purpose a fund of at least 3000*l.* will be needed, to which the committee now invites contributions. Nearly one-third of this amount has been subscribed by members of the committee. Cheques should be crossed Robarts, Lubbock and Co., and made payable to the treasurer, Lord Brassey, G.C.B., 24 Park Lane, London, W.

The interesting speeches made on the occasion of the presentation of a marble bust of the late Dr. John Hopkinson, F.R.S., to the Institution of Electrical Engineers on November 11, 1909, are printed in the journal of the institution (vol. xliv.). In making the presentation on behalf of his mother, Prof. B. Hopkinson did not claim too much when he said that "so long as dynamos are made, so long will the designers of such machinery, and the inventors of new forms of it, have first to master and then to use the fundamental principles which my father laid down." Mr. W. M. Mordey, president of the institution, in expressing the thanks of the council and members to Mrs. Hopkinson for the gift, pointed out some of the landmarks laid down by Dr. Hopkinson in connection with the development of electrical engineering. Dr. Hopkinson not only raised the knowledge of the dynamo from chaos into engineering and scientific order, but also made valuable contributions to subjects of purely physical interest. He was distinguished as an investigator, inventor, and teacher, and the marble bust at the Institution of Electrical Engineers will remind all who see it of a life to be emulated as well as honoured.

The third annual exhibition of the Society of Colour Photographers is now open at 24 Wellington Street, Strand, and will close on July 9. There is manifest a general levelling up in quality, and many, such as Mr. Hollyer's three-colour collotypes and Mr. Clifton's three-colour carbon prints, show what skilful manipulation can do with methods that allow much scope for error. Among the transparencies by the autochrome and similar processes are several examples on the new "Dufay" plates. The Thames Plate Company is bold enough to show four duplicates made from the same negative, and though any one alone might perhaps be accepted as satisfactory, the slight differences between the colours in the four prints demonstrate in an interesting way the difficulty of making two colour photographs exactly alike. Messrs. Mees and Pledge show an interesting series of photomicrographs of eight different kinds of three-colour screens, with various spectra and resolving power tests of colour plates. Dr. Mees also shows one of Mr. Ives's new colorimeters. The exhibition presents in a small space an excellent summary of the present condition and possibilities of colour photography from a practical point of view, together with many analytical results of especial interest to the scientific student.

The seventy-eighth annual meeting of the British Medical Association is to be held in London on July 22–29. The main business of the congress will be done in sections, which are, with their presidents, as follows:—anæsthetics, Dr. F. W. Hewitt, M.V.O.; anatomy, Prof. Arthur Keith; bacteriology, Dr. C. J. Martin, F.R.S.; dermatology, Dr. P. Abraham; diseases of children, Dr. A. E. Garrod; gynæcology and obstetrics, Dr. Mary Scharlieb; laryngology, Mr. H. Tilley; medical sociology, Dr. J. A. Macdonald; medicine, Dr. R. W. Philip; navy, army, and ambulance, Colonel A. Clark; odontology, Mr. J. H. Mummery; ophthalmology, Mr. C. Higgens; otology, Dr. E. Law; pathology, Mr. S. G. Shattock; pharmacology and therapeutics, Prof. A. R. Cushny, F.R.S.; physiology, Prof. W. H. Thompson; psychological medicine and neurology, Dr. T. B. Hyslop; radiology and medical electricity, Mr. J. M. Davidson; State medicine, Sir William Foster; surgery, Sir Victor Horsley, F.R.S.; and tropical medicine, Dr. F. M. Sandwith. The address in medicine will be delivered on July 27 by Dr. J. Mitchell Bruce, and the address in surgery on July 28 by Mr. H. G. Barling. The second annual meeting of the Medical Library Association, under the presidency of Prof. Osler, will be held on the mornings of July 27 and 28, at which papers will be read dealing with matters likely to be of practical interest and assistance to medical librarians, members of library committees, and readers. It is also intended to hold a bibliographical exhibition in connection with this meeting.

The Horniman Museum at Forest Hill continues to advance in popularity and in the interest of its collections. In the ethnological department the most important accessions during the past year have been collections from the north-west of North America and the Eskimo region, and a series illustrating the structure of the anthropoid apes. Arrangements have also been made for a good series of illustrative lectures. In that of natural history some progress has been made in collecting a series describing the structural adaptations of animals to the chief modes of progression, and increased accommodation for vivaria and aquaria has been provided.

The *National Geographic Magazine* for April, under the title of "The Spirit of the West," continues the graphic and well-illustrated series of articles by Mr. C. J. Blanchard, of the United States Reclamation Department, on the extensive works completed and in progress for extending irrigation in the Mississippi Valley. Thirteen million acres now produce harvests valued at 50,000,000*l.*, and support more than 300,000 families at present, with hopes of large increase in the immediate future. One of the most important of these works is the gigantic concrete dam, said to be the highest in the world, which bars the cañon of the Shoshone River collecting the drainage from the lofty mountains east of Yellowstone Park. This rises to a height of 328 feet, slightly higher than the summit of the dome of the Capitol at Washington.

In the second issue for the present year of the *Bulletins et Memoires* of the Société d'Anthropologie of Paris, Dr. A. F. Legendre publishes an elaborate anthropometrical study of that strange race, the Lolos of the Kien Tch'ang Valley, who have hitherto been a puzzle to ethnologists. In spite of the domination of the Chinese, who have taught them many vices, such as alcoholic drinking, they preserve some measure of independence, and in consequence of the ill-treatment to which they are accustomed they are so suspicious of strangers that there is much difficulty in investigating their ethnical characteristics. They seem to have decided affinity with the Tibetan stock, but they combine certain negroid characters with a curious fairness of skin. Dr. Legendre does not venture to give a decided opinion on their origin, but the elaborate measurements which he supplies will greatly assist in the solution of the problem.

In reference to the confirmation of the existence of pygmies in New Guinea, referred to in Nature (p. 433), it should have been noted that Dr. A. B. Meyer in 1908 wrote ("Die Papuasprache in Niederländisch-Neuguinea," *Globus*, Bd. xciv., p. 192):—"The question whether the Papuans are a uniform race with a great breadth of variation or a mixed race was pronounced by me to be not yet ripe for decision ('Negritos,' 1893, 87, and 1899, 87). Now, however, after Ray's discovery of the Papuan linguistic family, I incline to the view that they are a mixed race of 'Negritos' and Malays (in the wider sense). I am eagerly looking forward to the exploration of the interior of the great island, when here too the Negrito element may perhaps be brought to light in its old and more constant form as still existing in the Philippines, Andamans and Malakka."

In the April number of *Biometrika* there is an article by Prof. Karl Pearson on "Darwinism, Biometry, and some Recent Biology." The article, which apparently is to be continued in the next issue, is a general criticism of recent biological work in which more or less inadequate statistical methods have been used, with unfortunate results, but the greater part is devoted to a useful discussion of some of the difficulties that arise if the theory of "pure lines" is accepted in its most stringent form—*i.e.* the hypothesis that there is absolutely no individual inheritance within the "pure line." As Prof. Pearson correctly points out, if this conception were true the correlation between offspring and parent, and that between offspring and grandparent, would be the same in any case in which the reproduction was mono-sexual. The work of Warren on Daphnia and on Hyalopterus, and that of Johannsen himself on Phaseolus, indicate that this is not the case, the grandparental coefficient being very distinctly smaller than the parental coefficient. The fact that Johannsen, Raymond Pearl, and Jennings have failed to find any sensible effect of selection within the pure line may probably be ascribed to the fact that they have all been working with characters for which the coefficient of inheritance is exceedingly low; to arrive at an appreciable result a character should be selected for which the inheritance is relatively high. In any case, of course, it remains true that for breeding purposes it will be much better to select by the method of pure lines than by selection of the characters of individuals, but the effect of selection of individuals from the mass of the population is of vital importance for the theory of evolution.

In the June number of the *Selborne Magazine* Mr. G. S. Boulger directs attention to the enormous crop of seeds borne by many elms in England in the spring of 1909, the abundance of the crop being attributed to the fine autumn of 1908 and the sunny character of the following spring. The species which produced the seed is the smooth-leaved elm (*Ulmus glabra*), the common *U. surculosa* (or *campestris*) being infertile in this country. To the same issue Mr. J. Buckland contributes an article on the slaughter of egrets for the sake of their plumage.

Mr. N. N. Woronichin contributes to the botanical section (parts iii. and iv., 1909) of the *Travaux de la Société des Naturalistes de St. Pétersbourg* a list, with descriptions, of Rhodophyceæ collected in the Black Sea. The number of species amounts to ninety-seven, of which Polysiphonia and Ceramium supply twelve and ten respectively; some new varieties are distinguished. Two species are cited as endemic, while a Laurencia and Ceramium are noted as being recorded from the Atlantic Ocean and North Sea, but not from the Mediterranean.

A revised catalogue of microscopes and accessories issued by Messrs. W. Watson and Sons, High Holborn, London, contains descriptions of the essential working parts and full particulars of their various instruments, ranging from the school pattern to the microscopist's van Heurck type; a new introduction is the inexpensive naturalist's microscope intended for general use. Great variety is offered in the shape of objectives and condensers; for low-power photomicrographic use a series of holostigmatic lenses have been designed, which are used without eye-pieces. Accessories of all kinds are listed for microscopists, bacteriologists, biologists, and for commercial purposes.

A description of a singular purple-flowered Cytisus hybrid, for which an award of merit was given at the Temple Show, is communicated by Mr. R. A. Rolfe in the *Gardener's Chronicle* (June 18). The hybrid, *Cytisus* × *Dallimorei*, was raised in Kew Gardens by Mr. Dallimore from a crimson-winged variety of *Cytisus scoparius* crossed with pollen of the white broom, *Cytisus albus*. Of two seedlings obtained, only one produced purple flowers; the other bore flowers of a bright yellow. The purple colour of the seedling is traceable to the variety which is characterised by a deep crimson pigment in the wings and a slight tinge at the tip of the upper petal, the brown pigment, as the author suggests, being probably a suffusion of purple and yellow. Self-fertilised plants have been raised from both the yellow and purple hybrids, but, so far, the latter have not flowered.

The steady progress that is being made in the application of science to agriculture in the West Indies is well shown by a comparison of the Bulletin of the Department of Agriculture, Trinidad, recently issued (No. 64, vol. ix.), with the corresponding number for last year (No. 63, 1909). The earlier issue was filled with short notes, many of which were extracted from other journals, and did not represent anything in the way of original observations; the notes might be helpful to the planters, but they were more of the nature of useful hints than of reasoned discussions of the planters' problems. The present issue is a distinct advance. It contains papers by the members of the staff on important problems connected with rubber, cacao, and cocoa-nut. Mr. Carruthers discusses the possibility of growing rubber successfully, and points out that, in spite of certain obvious similarities, there are certain fundamental differences in the conditions obtaining in Ceylon or Malaya and those in Trinidad. Chief among these is the supply of labour, which is only small in Trinidad; in consequence, the planters could not keep the plantations anything like so clean as is done in the East, nor could the tapping be done as frequently. It does not

appear, however, that the difficulties are insuperable. Mr. Carruthers also writes on the cacao canker, caused by a fungus, probably by *Spicaria colorans*, but possibly also by others; Mr. Rorer is working at the problem, and will, it is hoped, be able definitely to allocate the responsibility for the mischief. Mr. Rorer describes the witch-broom disease of cacao, Mr. Johnston writes on the cocoa-nut palm diseases, and Mr. Urich on "froghoppers" in the sugar-cane (*Tomaspis postica*, Walk.). Messrs. Carmody and Verteuil record certain analyses of local value.

In a circular published by the U.S. Department of Agriculture (No. 118, Bureau of Entomology) Mr. F. M. Webster gives a description of a mite (*Pediculoides ventricosus*, Newport) occurring in grain which preys on the larvæ of the grain moth, adults of the barley joint-worm, &c. It also attacks man, causing an itching skin eruption.

An excellent little "Guide to the Preservation of Health in West Africa," by Dr. Strachan, C.M.G., principal medical officer of southern Nigeria, has been published by Messrs. Constable and Co., Ltd., price 6*d*. net. It deals in simple language with anti-malarial measures, the collection and storage of water, clothing, food, &c.

The Bulletin of the Sleeping Sickness Bureau (vol. ii., No. 17, May) contains a very complete scheme of investigation on the bionomics of the tsetse-fly, *Glossina palpalis*, which conveys sleeping sickness, and should be in the hands of all who desire to do research in this subject. So much still remains to be done that probably everyone in the endemic areas might, with the aid of a scheme like this, add his mite to our sum of knowledge.

The *Philippine Journal of Science* for December, 1909, contains several papers of considerable medical interest and importance. Messrs. A. F. Coca and P. K. Gilman record several cases of cancer treated with a "vaccine" prepared by grinding up a portion of the tumour removed by operation. The results seem promising. Dr. Clegg, by cultivating leprosy material on agar in symbiosis with amœbæ and cholera vibrios, claims to have grown an acid-fast bacillus which he believes to be the leprosy bacillus.

Prof. Minchin, in his presidential address to the Quekett Microscopical Club, discusses the phenomena of parasitism among protozoa. He concludes that "in the origin of species among parasites there are, as in other organisms, two steps: first, the appearance of variations, with the resultant disharmony seen in the lethal forms; secondly, by a gradual process of reciprocal adaptation between host and parasite, the establishment of more normal harmonic relations, associated with definite specific characteristics and reactions on the part of the parasite and the host" (Journ. Quekett Microscop. Club, April).

A recent publication from the Ottawa Government Printing Bureau contains a report by Mr. Einar Lindeman to the Canadian Department of Mines on the iron-ore deposits of Vancouver and Texada Islands, British Columbia. Mr. Lindeman dwells on the importance of local magnetic surveys in the immediate vicinity of the outcrops of magnetite, which are a common feature in the district referred to, and gives two interesting charts based on such surveys. Unless an appreciable disturbing magnetic force exists for some distance all round an outcrop, Mr. Lindeman thinks it is pretty safe to conclude that the extent of the deposit is very limited.

In the *Mémoires de l'Observatoire de L'Èbre*, No. 4, the Rev. J. García Mollá, S.J., describes the equipment of the electric section of the Observatory of the Ebro, founded a few years ago. The work—a French translation from the Spanish—is handsomely illustrated, and extends to more than 120 quarto pages. It describes the apparatus, including a water-dropping electrograph, an Elster and Geitel dissipation apparatus, a Gerdien instrument for air conductivity measurements, a ceraunograph, or wireless installation for recording thunderstorms, and an earth-current apparatus. Father García Mollá also discusses in a practical way a number of the difficulties encountered in working the instruments, and goes in considerable detail into the theory of the observations and their reduction. The electrical section is but one of several, and, so far at least as equipment is concerned, the observatory promises to afford remarkable facilities for the study of geophysics.

In a paper entitled "Storms and Storm-warnings on the German Coast in the Years 1896–1905," published in *Aus dem Archiv der Deutschen Seewarte* (vol. xxxii., part ii.), Dr. L. Grossmann discusses in great detail the storm frequency for various seasons and districts, and checks the accuracy of the signals hoisted by the Deutsche Seewarte in every imaginable way. An idea of the labour entailed in the investigation may be gathered from the fact that storm statistics have been tabulated from some 10,000 monthly registers supplied by the signal stations. The distribution of storms is divided into two principal types, those which spread in a W.-E. direction and those which take place in connection with depressions over north-east Europe and spread to the westward. About 70 per cent. of the storm phenomena over the North Sea reach the Prussian coast, while only some 47 per cent. of the storm phenomena on the latter coast also occur on the coast of the North Sea. The success obtained in warning of storms from easterly directions is not very satisfactory, especially in the summer months, but the success for those from westerly directions, especially in the winter season, is very considerable. These results agree in the main with those obtained in a similar inquiry for the preceding ten years (*Aus dem Archiv*, 1898).

Prof. Carl Barus, in a report published by the Carnegie Institution of Washington (pp. vi+83), gives an account of further experiments on "Condensation of Vapour as induced by Nuclei and Ions." The report begins with a chapter on the nuclei left behind on the evaporation of the pure water drops which are produced in moist, dust-free air when a sufficient degree of supersaturation is brought about by sudden expansion. The colour phenomena associated with clouds formed by expansion—a subject to which Prof. Barus has devoted much attention in previous researches—are dealt with in a second chapter. The principal advance here has been in the use of an approximately monochromatic source of light—the mercury green light—in the study of coronas. The rest of the report deals with the application of the corona method of estimating the number of cloud particles to the study of the ions due to radium, and the determination of the ionic charge. On the assumption that only the negative ions are caught in his experiments, he obtains for the charge carried by the ion values agreeing fairly well with those which have been arrived at by other methods. The object of the author's investigation was primarily to test the accuracy of his optical method of determining the number of nuclei. An interesting feature of the experiments is the scale on which they were carried out. Other physicists who have used the condensation method of measuring the ionic charge have worked with expansion apparatus in which the cloud chamber contained only a few c.c. of air; Barus used a fog chamber containing many litres, the number of ions

per c.c. being also large, ranging up to a million or more. The electrical quantities to be measured were thus of considerable magnitude.

PART viii. of the *Verhandlungen der deutschen physikalischen Gesellschaft* contains a paper by Dr. H. G. Möller on the calculation of the Foucault currents in iron. He considers the case of a cylinder of iron surrounded by a coil through which an alternating current is sent, and calculates the magnetic induction at any instant, taking into account the induced currents produced in the iron itself. With 100 cycles per second the B-H curves for low values of the maximum impressed H are almost identical with the ordinary magnetisation curves, but as the value of H is increased the hysteresis loop contracts near the origin. This result is in exact accord with the experiments made last year by Dr. Hausrath, and justifies the conclusion that the magnetisation in iron responds instantaneously to changes in the resultant magnetising force.

WE have received from Prof. Merczyng, of St. Petersburg, a separate copy of his paper on the indices of refraction of liquids for electric waves of small wave-length, which appeared in the April Bulletin of the Academy of Science of Cracow. The electric waves were generated by a Righi oscillator, and were measured by means of the interference produced by reflection at two metal surfaces, one a little in front of the other. The measurement gave 4·5 cm. The indices of refraction of the liquids were calculated by Fresnel's formula from observations of the relative intensities of the incident beam and the beam reflected from the surface of the liquid. They lie, for the five liquids tested, between the indices found previously by the late Prof. Drude for waves of 75 cm. and the values for light waves.

A SERIES of measurements of the temperatures of the metallic filaments of incandescent electric lamps has recently been made by Dr. M. v. Pirani at the lamp works of Messrs. Siemens and Halske, and the results are given in part vii. of the *Verhandlungen der deutschen physikalischen Gesellschaft*. The filaments were of platinum, tantalum, and tungsten, and were, in general, stranded. They were heated in an inert gas or *in vacuo* either by an external heating coil or by the current traversing them, and the temperature was measured by a standardised thermo-element of fine wire introduced between the strands. Up to a temperature of 1600° C. it was found that temperature t and current i were connected by the relation $i=a+b.t^n$, where a and b are constants and n has a value between 1·5 and 2·5. This relation was used to determine the temperature above 1600° C. Observations were also made of the "black-body temperature" of the filaments by a standardised radiation thermometer of the Holborn-Kurlbaum type using red light. Tables are given of the resistances of the filaments up to temperatures just below the melting points, and it is shown that at these points the black-body temperatures are about 150° C. below the actual temperatures.

THE quality of surface waters in the United States, by Mr. R. B. Dole, is the subject of water-supply paper No. 236, issued by the United States Geological Survey. The numerous analyses are chiefly of local interest, but the account of the methods employed is worthy of note. The highest accuracy consistent with rapidity of analysis was aimed at, and an estimate is given of the limits of accuracy achieved for each constituent. The methods of presenting the results of water analyses are also discussed, the ionic form of statement being regarded as the best, as it gives a statement of facts and not of opinion.

THE Stumpf uni-directional flow steam engine forms the subject of an illustrated article by Prof. Stumpf, of the Charlottenburg Technical High School, in *Engineering* for June 10. In this engine the steam is carried through the engine in an unchanged direction. The live steam is admitted from below into the cover, which it serves to jacket, and enters the cylinder through the valve. At the completion of the working stroke it is exhausted through slots or ports which are provided in the middle of the cylinder, and are uncovered by the piston. This avoids the losses common to ordinary engines by the cooling of the live steam ports produced by the flow of wet exhaust steam through them, and the consequent condensation in the cylinder. Prof. Stumpf claims that the remarkable advantages offered by this type of exhaust, notably the great simplicity of construction, render the uni-directional flow principle particularly valuable for engines working with superheated steam. Stationary and portable Stumpf engines of a great variety have already been built on the Continent, and their manufacture has been taken up in this country.

COMMENTING on the salving of the French submersible boat *Pluviose*, *Engineering* for June 17 states that the practice in all British submarines is to have a diving dress for each member of the crew stowed away adjacent to the station which he occupies when the boat is submerged. There is a flexible lead from the usual air service, with a valve in close proximity to each dress. In the event of an accident the dress can be put on in half a minute and supplied with air by means of the flexible lead. A purifier is fitted to the dress, which ensures a supply of air sufficient to last the man for an hour and a half. Training of the members of the crew to effect exit in the British service, is conducted in a tank, the bottom of which is fitted up to resemble a submarine boat, and the test imposed upon the prospective members of a crew is to plunge to the bottom of the tank in an air lock, where he is required to put on the diving dress, proceed across the tank, ascend the counterfeit of a conning-tower in a submarine, and open the hatch, when he is enabled to rise to the surface. The period occupied for training the men in this important work has been found by experience to be not more than five days. Although the conditions are not quite those existing in a submarine after an accident, yet the method appears to offer the only likely solution of a very difficult problem; it is simple, and provides, at any rate, that each member of the crew will have a chance of saving his life.

WE have received from the Caxton Publishing Company, Ltd., the first volume of "Nature-study on the Blackboard," by Mr. W. P. Pycraft and Miss J. H. Kelman, to be completed in three volumes at 7*s.* 6*d.* net each. We hope to review the work when the remaining volumes are available.

A SEVENTH edition of Mr. Charles Pendlebury's "Exercises and Examination Papers in Arithmetic, Logarithms, and Mensuration" has been published by Messrs. G. Bell and Sons, Ltd. About two-thirds of the contents of the present issue consist of new matter, and the portions of the older book which have been retained appear in a somewhat different order.

THE Selborne Society has issued the third of a series of leaflets on the Brent Valley Bird Sanctuary. This deals with curious nesting places, and, like those previously issued, is profusely illustrated, having been reprinted from *The Country Home*. Copies of the leaflet may be obtained

from Mr. Wilfred Mark Webb, honorary secretary of the Selborne Society, at 42 Bloomsbury Square, W.C., post free for three halfpenny stamps.

Messrs. Swan Sonnenschein and Co. will publish at an early date an English translation of "Spiritism and Insanity," by Dr. Marcel Viollet. This book forms part of the Library of Experimental Psychology and Metapsychism published under the direction of Dr. Raymond Marcel, of Paris, and has been translated by Mr. Dudley Wright, editor of the *Annals of Psychical Science*.

The report and transactions of the East Kent Scientific and Natural History Society for the year ending last September have reached us. The society is affiliated with the British Association and the South-eastern Union of Scientific Societies. The pamphlet, which has been edited by Mr. A. Lauder, the honorary secretary of the society, contains an account of the annual meeting in October, 1908, abstracts of the lectures delivered during the session, notes on the work done by the various sections of the society, and useful meteorological statistics for 1909.

Mr. W. Engelmann, of Leipzig, has lately issued the third (enlarged) edition of Ostwald and Luther's well-known work, "Hand und Hülfsbuch zur Ausführung physiko-chemischer Messungen." The first edition was reviewed in Nature of January 4, 1894 (vol. xlix., p. 219), and the second in the issue for December 4, 1902 (vol. lxvii., p. 101). The volume provides teachers and students with details of apparatus and practical hints on manipulation not found in any ordinary text-book, and the new edition claims a place in every chemical and physical laboratory. A second edition of Prof. M. Verworn's lectures on the mechanism of psychical life ("Die Mechanik des Geisteslebens") has been published by Mr. B. G. Teubner, Leipzig. This little work appeared in 1907, and the original edition was reviewed in Nature of April 16, 1908 (vol. lxxvii., p. 557).

Erratum.—In Nature of June 9 (vol. lxxxiii., p. 445), column A, line 15 from bottom, for "Thaumatocrinus" (a recent genus) read "Traumatocrinus" (a genus characteristic of Upper Trias).

OUR ASTRONOMICAL COLUMN.

July and August Meteors.—With the advent of July every meteoric observer is induced to make preparation for the active campaign which the season offers. After the middle of July meteors usually become extremely abundant, and any patient watcher of the skies may record a plentiful harvest of meteor-tracks. In May and June there are comparatively few shooting stars, and perhaps the average horary number is not more than four or six, but in the two succeeding months the rate of appearance often equals twenty or twenty-five per hour.

In July there is a very active display from Aquarius, which apparently reaches its maximum on July 27–31, though the meteors continue to fall from the same centre at about 339—11 during the first half of August—and in July there are many early Perseids displayed, though the latter are a different class of meteor to the Aquarids. Those which are directed from Perseus are of the swift, streaking order, while those from Aquarius are of the slow, trained variety, and they have long flights, the radiant being in low altitude.

This year both the Aquarids and Perseids may be observed to advantage, as the moon will offer little interference. On August 12, when we are led to expect the greatest abundance of meteors, our satellite will set at 10.9 p.m. and leave us with a dark sky, on which the meteors may be seen at their best; but, of course, in our English climate atmospheric conditions are always very doubtful. What we require is a series of beautifully transparent skies such as we experienced during the first half of August, 1909. Observers should seize such opportunities as are available and determine the place of the radiant and horary rate of meteoric apparitions on every clear night. The individual paths of those meteors equal to or brighter than first magnitude should be carefully recorded. The last few years have furnished average displays of Perseids; there is some reason to expect a richer shower this year.

The Lacings between Jupiter's Belts.—Circular No. 124 from the Kiel Centralstelle contains a telegram from Prof. Lowell, dated June 14, announcing that the "criss-cross filaments interlace all Jupiter's belts." This refers to the lacings first observed between the equatorial belts by Mr. Scriven Bolton, and apparently means that similar lacings have been observed between *all* the belts.

Observations of Orionids in 1909.—To No. 4418 of the *Astronomische Nachrichten* Prof. Dubiago communicates the results of the Orionid observations made at the Engelhardt and Kasan Observatories during October 17–20, inclusive, 1909. The times and apparent paths of ninety-six meteors were observed at the former station, and of forty-eight meteors at the latter. Eight meteors were observed at both stations, and for these real paths have been computed; the heights vary from 35 to 890 km. The following is the position of the radiant as determined from these observations:—$\alpha = 88° \pm 2{\cdot}9°$, $\delta = +21° \pm 1{\cdot}7°$.

The Cape Observatory.—Mr. Hough's report of the work done at the Cape Observatory during 1909 contains several items of special interest. Among other things, we learn that Dr. Halm's new spectrometer, giving direct readings of wave-lengths, was extensively employed for the measurement of stellar spectra, and the results found not to be inferior in accuracy to those secured by the older methods. It is also of interest to learn that arrangements have been made to take daily photographs of the sun to supplement those taken at Greenwich and other observatories in the Empire. A large number of stellar spectra were secured and measured in the research on the solar parallax and for the examination of the systematic motions of stars in the line of sight. For Prof. Kapteyn's "Selected Areas" programme a number of proper-motion and parallax plates were secured; satisfactory progress in the *Carte du Ciel* programme is also reported.

THE TRANSIT AND TAIL OF HALLEY'S COMET.

The question as to whether the earth passed through the tail of Halley's comet is discussed, from the point of view of the Helwan observations, by Mr. Knox Shaw in No. 4418 of the *Astronomische Nachrichten* (p. 31). On May 18, at 13h. G.M.T., the tail was seen to stretch as far as α Equueli, where it was 2° broad, although 8° broad where it involved γ Pegasi. At 13h. on May 19 there was no sign of the tail in the west, but it was traced to θ Aquilæ, where it merged with the Milky Way. The form was still tapering, and was 15° broad at α Pegasi. Similar observations followed on May 20, when still no tail was seen in the evening; but at 14h. it was traced to the Milky Way, and was about 10° broad in Pegasus. At 6h., G.M.T., on May 21 the tail was visible for a distance of 20°, but none could be seen at dawn. The narrowness of the tail (8°) on May 18 and the increased breadth next morning suggest that it was bent back in the orbit, and probably did not begin to sweep past the earth before 12h. on May 20. At this time the earth was some four million miles south of the comet's orbit plane, and consequently the tail probably passed well to the north of the earth, for the Helwân observations, during May, suggest that it was not nearly wide enough to envelop the earth at that distance. They also show that its length was well over twenty million miles, and would therefore have enveloped the earth had the planes coincided. No sign of the comet's transit of the sun's disc was observed, although observations were made with the 4-inch Cooke equatorial. Dr. Meyermann also reports that, at Tsingtau, no trace of the comet was seen during the transit, nor were any extraordinary magnetic or meteorological effects recorded by the respective instruments.

Observations at the Stockholm Observatory were interfered with by heavy skies, but Dr. Bohlin reports that some photographs were obtained on orthochromatic plates used in conjunction with a yellow screen.

Further negative results, accruing from careful observations made on May 18 and the following days, are recorded by Father S. Chevalier in a special circular from the Lô-Sè Observatory. The sun was observed directly and by projection by several observers, but no trace of the comet was seen on the disc about the computed time of transit. Photographs were also obtained, and clearly showed dark pores of 2″ diameter on the disc, but no trace of the comet. It therefore appears unlikely that any part of the comet having a diameter of 0·5″, or, actually, 60 km., was dense enough to be registered on the plate. The magnetic curves, of which reproductions accompany the circular, obtained at the Lu-Kia-Pang Observatory on May 17, 18, and 19, show no perturbations which could with certainty be ascribed to cometary influence.

The *Comptes rendus* for June 13 (No. 24) contains several interesting notes concerning observations of the comet at various observatories.

M. Marchand reports that at the Pic-du-Midi station the solar halo seen from May 19 to 25 was still visible on May 31 and June 2 with the same diameter, 3° or 4°, but much paler, and a notable sunset effect was seen on May 31. Such an effect has not been recorded for several years, and is ascribed to the presence of very tenuous matter in the atmosphere at great altitudes.

MM. Cirera and Pericas describe the varying forms of the comet as observed at the Observatoire de l'Èbre (Spain) from May 1 to June 6. A table of the apparent and real lengths—the latter given in astronomical units—shows that up till May 12 the increase in the length of the tail was continuous, but a decrease was noted on May 26, followed by further progressive increase until June 2; observations on some of the intermediate dates were interfered with by clouds. It is suggested that the fluctuation was possibly produced by the earth capturing several million kilometres of the tail during the predicted passage on May 19. Photographs were secured on a number of dates during May and the first week in June, but bad weather prevented a continuous series from being obtained. The series shows, however, some striking changes in the form, extent, and brightness of the nucleus and head, especially about May 27; on May 30 the coma was much less bright and extensive.

M. Eginitis reports on the observations of the tail, made at the Athens Observatory on May 18, 19, and 20. On the Thursday morning, about an hour before the computed time of passage, the tail was seen to be nearly straight, but having a slight curvature, which may have been due to the proximity of the earth to the comet's orbit plane. At 3 o'clock on the Friday morning the tail was nearly 130° long, but no trace of it could be found on the Saturday morning. On the Friday evening, however, it was seen, like a crescent moon, and on Saturday evening was some 30° long. Observations of the sun's disc during the time of transit failed to reveal any sign of the comet.

MM. J. Baillaud and Boinot discuss, in detail, the transformations of the nucleus depicted on the photographs taken at the Paris Observatory on May 30 and 31 and June 2. A sudden transformation took place in the nucleus on May 31, the previously extensive elliptical form giving way to a circular condensation with bright extensions. Secondary condensations appeared, some of which were only temporary; but one of them persisted undiminished until June 2, and the authors liken the phenomenon to the doubling which occurred in the case of Biela's comet.

In No. 6, vol. lxx., of the Monthly Notices (R.A.S.) Dr. Rambaut publishes positions of the comet determined from photographs secured at the Radcliffe Observatory, with the 24-inch telescope, between November 7, 1909, and February 11. Such places depending upon stars generally taken from the Astrographic Catalogue will be invaluable in the subsequent discussions of the orbit; the comet was first picked up at the Radcliffe Observatory on November 5, 1909.

Mr. H. H. Gruning, of Ealing, sends us an interesting account of his observations of the comet. Between April 18 and June 18, using five-times field glasses (2-inch aperture), he saw the comet fourteen times, and on ten of these occasions it was visible to the naked eye. No tail was seen except on May 31 and June 1, when, with the glasses, h was able to follow it to a distance of 1°. These carefu made observations well illustrate, when compared with th glowing reports from lower latitudes, the disadvantag under which we, in this country, have laboured during th present return of the famous comet.

Another correspondent sends us a cutting from th *Lancashire Daily Post* for June 1, in which Mr. Whitaker reports a remarkable phenomenon observed a Salterforth at about 3.30 a.m. on May 26. According t this report, a tail about 40° in length was seen risin from the eastern horizon. It would be of interest to hav further records of this curious phenomenon.

THE ROYAL SOCIETY OF NEW SOUTH WALES.

THE Royal Society of New South Wales is the oldes scientific society in Australasia and in the souther hemisphere, unless there are older ones in South Americ or South Africa, and it will be able to celebrate it centenary in another eleven years.

It was started in 1821 in a similar way to the Roya Society of London, under the name of the Philosophica Society of Australasia, by a small band of friends, ten i number, under the presidency of the Governor, Sir Thoma Brisbane, K.C.B., F.R.S., who met at each other's houses where papers were read and discussed; there was a penalt of 10*l.* for any member failing to present a paper in hi turn. They also lent each other books, as there was n public library in those days and hardly a bookseller in th whole of Australia.

The first members were Mr. Alexander Berry, whos brother, Mr. David Berry, died in 1889 at the age of ninet seven, and left 100,000*l.* to his Alma Mater, St. Andrew University, N.B., and the same amount to found a hospit in New South Wales—the writer of this, a member of th society, knew Mr. A. Berry, and thus the chain of member ship has been kept up since 1821; Dr. Henry Gratta Douglas, who in after years was one of the prime mover in founding the first university of Australia, viz. th University of Sydney; Judge Barron Field, of the Suprem Court of Australia, author of a work upon Australia, pub lished by John Murray in London in 1825; Major Gou burn, Colonial Secretary; Mr. Patrick Hill, Coloni Surgeon; Captain Philip Parker King, R.N., afterward F.R.S. and Rear-Admiral, a son of Philip Gidley Kin third Governor of New South Wales, who surveyed th north coast of Australia, and later on was engaged in th *Adventure* and *Beagle* surveying expedition along th coast of South America—it is interesting to note th the Hon. Philip Gidley King, M.L.C., a son of Admir Philip Parker King, born in 1817, served as an officer o board the *Beagle* with Charles Darwin, and was a membe of the society until four or five years ago; Lieut. Joh Oxley, R.N., Surveyor-General, who was one of the dis tinguished early explorers in Australia; Dr. Charl Staggard Rumker, astronomer, who started the firs observatory in Australia; and Mr. Edward Wolstonecraf As previously stated, the Governor, Sir Thomas Brisban F.R.S., was the president. For many years the Govern of Australia, and later of New South Wales up to 187 was always the president, and some of the earlier one like Sir T. Brisbane and Sir W. Denison, F.R.S. (afte wards, for a short time, Governor-General of India), wer men of scientific attainments who not only took a speci interest in the society, but attended its meetings regularl and contributed several papers.

Some of the first papers read before the society wer collected by His Honour Judge Barron Field, and pub lished by John Murray in a book entitled "Geographic Memoirs of New South Wales," and it is interesting t note that the subjects which engaged the attention of th members in those early days are typical of the majorit of the papers presented to the society ninety years later e.g. the following were amongst those read in 1822:— (1) on the aborigines of New Holland and Van Diemen Land, by Barron Field; (2) on the geology of part of th coast of New South Wales, by Alexander Berry; (3) o the astronomy of the southern hemisphere, by D

:umker; (4) on the maritime geography of Australia, by aptain Philip Parker King, R.N.

After a period of inactivity the society was resuscitated 1 1850 under the title of the "Australian Philosophical ociety," instead of Australasian, because, as the colony f Tasmania had been taken out of New South Wales in 825, the term Australasian was no longer applicable. In 856 the name was again altered, this time to that of 'hilosophical Society of New South Wales, a further slice f New South Wales having been cut off to form the olony of Victoria. In 1866, by permission of H.M. Queen 'ictoria, it assumed its present title of "Royal Society f New South Wales," and in 1881 it was incorporated by n Act of the New South Wales Parliament.

The principal reason for discarding the term "Philoophical" was because the object and work of the society ould not be considered as coming under the head of hilosophy, and as the ground covered by the Royal Society f London was so well known, the then members decided o apply to the Crown for permission to use the more omprehensive title of "Royal"; this title had already een granted to the corresponding society in Tasmania. n later years the Philosophical Societies of Victoria, South ustralia, and Queensland also changed their names in he same way.

The society was not in a position to publish until 1862; rior to that date some of its papers were printed in the laily newspapers, and others, up to 1859, appeared in the *ydney Magazine of Science and Art*; several of these early apers are still of value, apart from the interest attached o the efforts of the authors to do what they could for the rogress of science in a new country; and all honour is lue to the early pioneers, for they worked under great lifficulties, without the aid of libraries, collections, and nodern instruments and appliances, and at a time when t took from six to nine months to get a reply from home, nd their work should not be forgotten.

So early as 1851 the society endeavoured to encourage the development of the natural resources of the colony by offering gold medals for the growth and production of madder, cotton, and sugar, and for the extraction of metals from colonial ores.

Later on, to stimulate and encourage scientific research, the society for some years, viz. from 1882 to 1896, offered a medal (and a grant of 25*l.* to help defray the expenses of the investigations) for original researches and observations upon certain specified subjects, of which notice was given three years in advance, but after fourteen years' experience it was decided to discontinue these competitions. The following list gives an idea of the range of the subjects:—the chemistry of the Australian gums and resins; the tin deposits of New South Wales; the iron ore deposits of New South Wales; the marine fauna of Port Jackson; the silver ore deposits of New South Wales; on the origin and mode of occurrence of gold-bearing veins and of the associated minerals; influence of the Australian climate in producing modifications of diseases; on the Infusoria peculiar to Australia; anatomy and life-history of the Platypus and Echidna; anatomy and life-history of Mollusca peculiar to Australia; the chemical composition of the products from the so-called kerosene shale of New South Wales.

The society now awards one medal only, viz. the medal which was established, together with a lectureship, in memory of the late Rev. W. B. Clarke, F.R.S.; amongst the non-resident recipients of this medal have been:—Sir Richard Owen, F.R.S., 1878; Prof. George Bentham, F.R.S., 1879; Prof. Huxley, F.R.S., 1880; Prof. James Dwight Dana, 1882; Baron von Mueller, 1883; Alfred R. Selwyn, F.R.S., 1884; Sir Joseph Dalton Hooker, 1885.

From 1866 to 1875 the papers read before it were published under the title of "Transactions," but this was considered rather pretentious, and in 1876 they were brought out as the "Journal and Proceedings" as an annual volume; later they were issued for a few years in parts, and this method has been revived.

The volumes, of which forty-three have been issued, vary in size, but those for the last thirty years run from 300 to more than 600 pages. They are well printed in good type on good paper, and well illustrated.

The papers naturally are, for the most part, devoted to Australasian subjects; those upon astronomy, meteorology, geology, mineralogy, botany, ethnology, water supply and irrigation, and similar matters bulk most largely; some of the papers are, and will remain, of permanent interest. The first eleven volumes are out of print and are difficult to obtain, but, fortunately, the volumes have been widely distributed to public institutions and societies in all parts of the world, so that anyone really interested can generally manage to refer to them.

It is not proposed to give any specific account or review of the recently published volumes, inasmuch as abstracts of all the principal papers read have appeared in the columns of NATURE month by month during recent years under the head of "Societies and Academies." The volume for 1909 has been issued in four parts instead of the single annual volume, in the hope that its usefulness may be increased, and the society is to be congratulated upon having done so.

In 1875 a series of sections was inaugurated in order that the members might be able to meet together for the discussion of matters of scientific interest with less formality than at the ordinary meetings of the society; some of these were very successful, and they helped to make the society more popular, and the number of members rapidly increased to 494, the largest during its history; but of late years interest in the sections has decreased. The medical section was a very active one for several years, and did useful work until it was superseded by the formation of an outside independent professional society.

The engineering section is at the present the only active one, and it is doing extremely good work, as shown by the papers and proceedings appearing in the society's volumes; it practically supplies all the advantages afforded by an independent society, and, further, has the use of the Royal Society's library, meeting rooms, printer, office staff, &c., without any extra subscription.

Most of the other sections will probably re-awaken to their former activity in due course. The sections are:—A, mathematics, physics, astronomy, meteorology, &c.; B, chemistry and mineralogy, and their application to the arts and agriculture; C, geology and palæontology; D, botany and zoology; E, microscopical science; F, geography and ethnology; G, literature and the fine arts, including architecture; H, medical science; I, sanitary and social science and statistics; J, engineering science; K, economical science.

The society distributes its publications to about 400 similar societies, institutions, and public libraries, not only to all parts of the British Empire, Europe, and America, but to China, Japan, Mexico, the Philippines, Straits Settlements, Chili, Peru, Mauritius, Brazil, &c., and in almost all cases receives publications from these places in exchange. At one time the society undertook the collection and delivery of scientific publications for other institutions in New South Wales, but this is now done by the Government Bureau for Scientific Exchanges. In addition to the exchange of publications, the society endeavours to maintain touch with scientific workers in other parts of the world by appointing a limited number of non-resident men of science as honorary members; the society has had special pleasure in the acceptance of its honorary membership by such men as Darwin, Hooker, Wallace and others, who have done scientific work in Australasia and Oceana.

In addition to its ordinary meetings, the society arranges for series of popular lectures, to which friends of the members are freely invited, and short courses of lectures are also given upon the geology of Australasia, known as the Clarke lectures, founded in memory of the Rev. W. B. Clarke, F.R.S., a former president of the society, who gave a large part of a long life to geological research in Australia.

It also gives an annual conversazione, which is held at the University, on account of the extensive and suitable accommodation afforded by it, as the conversazione is very popular and largely attended; all the scientific departments, laboratories, the libraries, and lecture rooms are thrown open for the occasion, and suitable exhibits of new apparatus and specimens are shown in them, as well as experiments and practical illustrations where possible. Lecturettes are given upon recent discoveries or matters of interest.

Usually some of the visitors attending the lectures and conversazione become sufficiently interested to join the society and become useful members; the University also profits in turn, as the conversazione enables many persons to see it and learn what it is doing who otherwise would not have an opportunity.

The society does not restrict itself to work which is done by its own members, but, where possible, it is always willing to assist others; *e.g.* it greatly assisted in the formation of the Australasian Association for the Advancement of Science; it also took an active part in the foundation of a marine biological laboratory near the entrance to Sydney Harbour, which, unfortunately, was required a few years afterwards by the Government for defence purposes, and it is to be hoped that the trustees, who received compensation from the Government, will see their way before long to start a new marine station and laboratory; it has on several occasions brought matters of importance under the notice of the Government where legislation has been necessary for the good of the public health, the preservation of the native flora and fauna, also for the assistance of scientific exploring expeditions in the Antarctic and elsewhere and in other similar matters, and it has helped in the extension of the British Science Guild in Australia.

For many years it has been one of the main objects of the society to get together a good library of the principal British, American, French, German, and other scientific journals, and it now has complete series of many of these, some by purchase, others by gift and in exchange for its own publications, so that, taking the limited resources of the society into account, quite a creditable and useful library has been gradually built up. Without such books of reference the research student is at a great disadvantage, and the society regards the formation of such a reference library as of equal importance to the publication of papers read before it.

In 1878 the society obtained possession of its present freehold premises in Elizabeth Street, Sydney. Since then it has twice added to them, in 1896 and again in 1905; the last time it was to increase the accommodation required for the growing library, and also to provide accommodation for kindred societies by sub-letting some of the rooms, not immediately required, to them at low rentals; in this way it affords (as was stated in an article on the Australasian Association for the Advancement of Science, NATURE, December 30, 1909) some of the advantages enjoyed by the English societies in Burlington House.

The Parliament of New South Wales has generously helped the society for some years; for several years the Government printed the society's annual volume of papers and proceedings; of late years, in place of printing the volume, it has contributed 10*s.* per annum for each 20*s.* of the members' subscriptions; but, in spite of this, the society's income is insufficient to enable it to undertake many things it would like to do for the advancement of science, and it finds difficulty in carrying on its present efforts.

A. LIVERSIDGE.

THE AMERICAN PHILOSOPHICAL SOCIETY.

THE general meeting of the American Philosophical Society was held at Philadelphia on April 21–23, and we have been favoured by the secretaries with a report of the proceedings. The afternoon of April 23 was devoted to a symposium on experimental evolution, the principal papers being given by Prof. H. S. Jennings, on inheritance in non-sexual and self-fertilised organisms; Mr. G. H. Shull, on germinal analysis through hybridisation; and Dr. C. B. Davenport, on new views about reversion.

At the session on April 22 the following were elected to membership:—*Residents of the United States:* Dr. S. E. Baldwin, Dr. F. G. Benedict, Dr. C. F. Brush; Dr. D. H. Campbell, Dr. W. E. Castle, Dr. G. B. Gordon, Dr. D. J. Hill, Dr. H. C. Jones, Dr. L. Loeb, Mr. J. McCrea, Dr. R. C. Maclaurin, F.R.S., Dr. B. O. Pierce, Dr. H. F. Reid, Dr. J. F. Rhodes, and Dr. O. W. Richardson. *Foreign residents:* Dr. A. von Baeyer, Madame S. Curie, Sir David Gill, K.C.B., F.R.S., Dr. E. Meyer, and M. C. E. Picard.

In addition to the symposium on evolution, fifty-one papers were presented. Brief summaries of the contents of a few of these papers are subjoined.

Physical notes on Meteor Crater, Arizona, Prof. W. F. Magie. Meteor Crater is a vast crater situated in Coconino County, Arizona, formed by the impact of an iron meteorite or group of meteorites. Scattered specimens of these meteorites (the Canyon Diablo siderites and the "shale ball" siderites) are found around the crater, but the main mass has not yet been found. It probably is buried 1000 feet below the surface. (1) The Canyon Diablo iron shows a magnetic permeability not very different from that of cast iron. The shale ball iron seems to be generally similar to it in its magnetic properties. Several observations indicate an intrinsic magnetisation, peculiarly arranged, in the shale ball iron. The magnetic field of the crater shows no local peculiarities such as would be expected from the presence of a large continuous mass of iron. The inference is that the mass is fragmentary, perhaps intrinsically magnetised, and also, perhaps, largely oxydised. (2) The distribution of the ejected material and the inclinations of the exposed strata around the crater wall show a remarkable symmetry with respect to a nearly north and south axis. This symmetry, even in details, appears in holes made by bullets in a suitable mass of compacted powder. The inference is that the crater was formed by a projectile. (3) The mass ejected is estimated at 330 million tons. The energy used to lift it out of the hole is a negligible fraction of the energy expended. Most of the energy expended was used in crushing the rock. An estimate based on the assumption that the powdered sandstone was heated to 2500° C. would indicate an expenditure of $92 \cdot 5 \times 10^{12}$ ft. tons of energy. Taking everything into account, it seems reasonable to estimate in all an expenditure of 60×10^{12} ft. tons of energy. Taking this for the energy expended, and estimating the probable velocity of the meteor as lying between three and forty-eight miles a second, the mass of the meteoric group would lie between fifteen million and sixty thousand tons. The size and shape of the crater lead one to estimate a mass larger than this lowest limit, and the final estimate is that the mass is 400 thousand tons, and that its velocity was from eighteen to twenty miles a second.

The conversion of the energy of carbon into electrical energy by solution in iron, Prof. Paul R. Heyl. It is found that carbon dissolves in molten iron with a liberation of energy, which, by providing a suitable negative element, may be obtained as an electric current. The electromotive force thus developed has not yet been definitely determined, but is probably not more than one- or two-hundredths of a volt. There is no possibility of compounding this electromotive force with the accompanying thermal effect, as the two are opposite in direction.

The one-fluid theory of electricity, Prof. F. E. Nipher. The author has shown in a former paper that what have been taken for discharges from the positive terminal of an electrical machine are really optical illusions. The positive discharge is really an inflow of the electrical discharge which flows outward from the negative terminal. This is in harmony with the one-fluid theory of Franklin. With this paper he presents photographic plates showing the discharge from its first stages until the disruptive spark appears. These plates fully confirm the former conclusion that there is no positive electrical discharge. The discharge comes from the negative terminal and goes to the positive. The illusion which has led to the idea of a positive discharge is compared to one which might prevail if Niagara Falls should suddenly recede from Lake Ontario to Lake Erie. It might deceive us into the idea that there had been a positive discharge into Lake Erie.

The past and present status of the æther, Prof. A. G. Webster. The history of the conception of the luminiferous æther was covered from the time of Newton and Huygens to the present. For the last hundred years the belief in the æther as necessary to transmit light has been universal. Lord Kelvin devoted most of his life to establishing its properties. The various mechanical theories were succeeded by Maxwell's successful electromagnetic theory, confirmed twenty years later by the electric wave experiments of Hertz. To explain astronomical aberration and the phenomena due to the earth's motion, Maxwell's theory was severely strained, and was perfected by Lorentz. The

lassic experiment of Michelson on the apparent fixity of he æther of the earth in its motion was explained by Lorentz, though by the violent assumption that motion changes the dimensions of bodies, and that the local time of a moving observer is different from that of an observer at rest. From this comes Einstein's principle of relativity, which profoundly modifies our ideas of space and time, and leads many radicals to abandon the æther.

The æther drift, Prof. Augustus Trowbridge. Prof. Trowbridge spoke very briefly upon the general question of relative motion of matter and the æther-nest to point out that, in spite of the experimental work of various investigators, we are still in doubt as to whether the earth in its motion through æther-filled space entrains the æther in its motion or not. Next, he explained in what respect the experimental method adopted by Prof. Mendenhall and himself differed from that of former investigators so as to be free from the objections which have rendered the previous work inconclusive.

The effects of temperature on fluorescence and phosphorescence, Prof. E. L. Nichols. A summary of observations on the fluorescence and phosphorescence from temperature of liquid air to ordinary temperatures, showing that the theory of Lenard is inadequate to correlate all the facts.

Infra-red and ultra-violet landscapes, Prof. R. W. Wood. Photographs taken with infra-red and ultra-violet, using appropriate absorption screens, show greatly altered contrasts. Thus some substances which are white when viewed by ordinary light appear black when photographed with ultra-violet light. By such photographs it may be possible to obtain additional details concerning the surface markings of the moon and planets.

The cause of epidemic infantile paralysis, Dr. S. Flexner. A report on the experimental study of piliomyelitis in monkeys, which has yielded a large number of important facts relating to the spontaneous disease in man. The nature of the virus has been discovered, many of its properties have been ascertained, some of its immunity effects have been established, the clinical and pathological peculiarities of the disease have been elucidated, and a basis has been secured on which to develop measures of prevention.

Dermal bones of Paramylodon from the asphaltum deposits of Rancho La Brea, near Los Angeles, California, W. J. Sinclair. This paper describes the mode of occurrence, shape, and microscopic structure of the skin bones of an edentate animal from the Los Angeles asphaltum beds. These bones, which are small, pebble-like elements in the skin, resemble closely similar bones occurring in a piece of skin found in a cave at Last Hope Inlet, Patagonia. They are also known to occur in Mylodon, a genus of ground sloths formerly living in North and South America. As the structure of the skin bones in Mylodon is quite different from what it is in Grypotherium, the form from the Last Hope Inlet locality, it was a matter of interest to find out to which of these genera the specimens from the asphalt showed the closer resemblance. Thin sections of the bones were cut, and these prove that Paramylodon from the asphaltum beds is almost identical, in the structure of the skin bones, with Grypotherium, a contemporary of early man in Patagonia.

A note on Antarctic geology, Prof. W. M. Davis. It is well known that fossil plants have been found in various formations in the Arctic and Antarctic regions, indicating the former prevalence there of a much milder climate than that of to-day. Our prepossession naturally favours the present polar climate as having been the ordinary or normal polar climate of all geological time; but inasmuch as milder climates have sometimes occurred, it is eminently possible that they, and not the present rigorous climate, may have been the usual polar climate through the geological ages. Hence a peculiar interest attaches to studies of the minute structures of stratified formations, particularly of such as are of continental origin, for from such studies it may well be possible to determine climatic conditions even in the absence of fossils.

Some recent results in connection with the absorption spectra of solutions, Prof. H. C. Jones. The absorption spectra of dissolved substances are not simply a function of the nature of the substances, but also of the nature of the solvents. When a salt like uranyl chloride is dissolved in water we have one spectrum in water, another in alcohol, still another in acetone, and a spectrum in glycerol which is very different from any of the above. The only way in which we can account for these results is in terms of the solvate theory. The different solvents combine with the dissolved substance and form solvates having very different compositions. These affect the resonance of the vibrators that are the cause of light absorption differently, and, consequently, the absorption in the different solvents is different. The second point upon which stress is laid has to do with the action of one acid on the salt of another acid. In terms of prevailing chemical theories, when a salt of one acid is treated with a small amount of another acid, a part of the salt is transformed into the salt of the second acid. With the addition of more and more of the free acid, more and more of the initial salt would pass over into the salt of the second acid. In such solutions we should expect to have the bands of both salts occurring simultaneously, with varying intensity, depending upon the amounts of the two salts present. The fact is that when a salt is treated with a free acid we have neither the bands corresponding to the initial nor the final salt present, but bands occupying positions intermediate between those of the two salts, and these bands can be made to occupy any intermediate position by suitably varying the amount of the free acid relative to the salt. This shows that between the initial salt and the one finally formed there is a series of intermediate compounds or systems corresponding to the various positions of the bands. The number of reactions showing the above relations is not small, and this raises the question whether chemical reactions in general are not much more complex than is usually represented by our chemical equations, which deal only with the initial and final stages.

Suppression and extension of spore-formation in *Piper betel*, Prof. D. S. Johnson. The interesting feature of the structure of the flower in this plant is the presence of male flowers, female flowers, and flowers bearing the organs of both sexes, on three separate kinds of spikes; but flowers of each sex often bear some rudiments of organs of the other sex. This shows that while some flowers are apparently of one sex only, they really possess, in some degree, the power to develop the organs of the opposite sex. In other words, the cells from which the flowers arise are capable of forming the organs of both sexes, and the fact that one sex only is formed is probably due to some influence, internal or external, affecting the cells at the time that the flowers are being initiated. Experimental work on certain plants has shown that a change in the light or soil supplied to apparently unisexual individuals may cause the organs of the other sex also to appear. This seems clear evidence that both sexes may really be present in all apparently unisexual plants, but that sometimes one, sometimes the other, of these is suppressed or fails to become evident. The only plants of which this seemingly cannot be true are those well-known unisexual plants like the sago palm, cottonwoods and willows, in which each individual bears only male flowers or only female flowers year after year throughout the life of the plant. Another case is that of one of the mosses, in which it has been shown by Noll that the sex remains constant for thirty generations when male or female plants are propagated by budding.

Solar activity and terrestrial magnetic disturbances, Dr. L. A. Bauer. A recent examination of the times of beginning of magnetic disturbances, as recorded at observatories over the entire globe, showed that, without doubt, magnetic storms do not begin at absolutely the same instant of time, as heretofore believed. Instead, they progress around the earth, the times generally increasing as we go around the earth eastwardly; for the quick and abrupt disturbances, which are usually comparatively minute in their effect on the compass needle, the complete passage around the earth required from three to four minutes. For the bigger effects, or for the greater magnetic storms, the rate of progression is slower, so that it would take them half an hour or more to get around the earth completely. There is thus introduced a new point of view in the investigation of the origin of magnetic storms. In addition to negatively charged electrified particles coming from the sun, to which recent theories sought to attribute our magnetic storms, but which the author found would produce effects not in harmony with

those actually observed, we also receive radiations, such as the Röntgen rays, for example, which are not deflected by the earth's magnetic field, as they do not carry electric charges. Their chief effect will be to ionise the gases of which the atmosphere is composed, *i.e.* make the air a better conductor of electricity. Ultra-violet light has the same effect. It is known that a small part of the magnetic forces acting on a compass needle is due, not to the magnetism or electric currents below the earth's surface, but to electric currents already existing in the atmosphere, and which the speaker showed were brought about by the atmosphere cutting across the earth's lines of magnetic force in its general circulation around the globe. If the regions of these upper electric currents are at any time made by some cause more conducting, electricity will be immediately set in motion, which in turn affects our compass needles. This new theory, called "the ionic theory of magnetic disturbances," satisfactorily explains the principal features of magnetic storms. As the currents get lower down in the atmosphere their velocity is checked, so that, instead of taking but three to four minutes to circulate around the earth, as do the higher currents, it may take them half an hour and more; however, their actual effect on the magnetic needle would be greater, because of their coming nearer to the earth. The theory also opens up the possibility of accounting for some of the other changes and variations experienced by the earth's magnetism, and likewise has a bearing on the peculiar formation of the magnetic fields in sun-spots discovered by Prof. Hale.

Magnetic results of the first cruise of the *Carnegie*, Dr. L. A. Bauer. The non-magnetic vessel *Carnegie* completed on February 17 the first cruise, covering in all, since September 1, 1909, 8000 miles. Special tests made at Gardiner's Bay, Long Island, and at Falmouth, England, proved conclusively that there are no corrections to the magnetic instruments of the kind encountered on vessels in which more or less iron occurs in the construction. Thus in a single voyage errors could be disclosed in the compass charts used by mariners on their Transatlantic voyages between New York and England of importance, not alone from a purely scientific standpoint, but from that of practical and safe navigation as well. The errors found by the *Carnegie* in the declination at various points along the track followed by the vessel amounted, on the average, to about 1 degree—an error which persisted in the same direction for long distances. After leaving Falmouth the *Carnegie* headed for Funchal, Madeira. From thence she sailed to Bermuda, and finally arrived at Brooklyn on February 17. In spite of the unusually adverse conditions frequently met with during this first cruise, more or less extensive magnetic observations were secured almost daily. The errors of the compass charts were found, in general, even more pronounced for the southerly half of the cruise, viz. Madeira to Bermuda, than for the northerly half, and were again shown to be systematic in their nature. Some of the charts were in error 2 to 3 degrees. For the entire cruise important corrections were also disclosed for the magnetic charts which give the lines of equal magnetic dip and of equal magnetic force. The *Carnegie* is now being fitted out for a circumnavigation cruise of about three years. In the meantime, the magnetic surveys of unexplored countries are pushed on, so that it is confidently expected that by the year 1915 the general magnetic survey of the greater part of the globe will have been completed in sufficient detail to permit the construction and issuing of a new set of magnetic charts.

On the distances of red stars, Prof. H. N. Russell. Comparison of the parallaxes of stars, derived by the author from photographs taken at the Cambridge Observatory (England) by Mr. A. R. Hinks and himself, and their spectra, determined at Harvard under the direction of Prof. Pickering, shows a marked correlation between spectral type and parallax. The proportion of orange and red stars (types K and M) among those of large proper motion, and especially among those shown by direct measurement to be our near neighbours, is very much greater than among the general run of stars of the same apparent brightness. Conversely, stars of the same apparent brightness and proper motion are, on the average, nearer to us the redder they are. It follows that these stars are intrinsically fainter the redder they are, the reddest ones being, on the average, only one-fiftieth as bright as the sun. On the other hand, many bright red stars (such as Arcturus) are at great distances, and are actually at least 100 times as bright as the sun. All this can be explained on the hypothesis (now well established on other grounds) that the reddest stars are the lowest in temperature. With the latest determinations of temperature and surface brightness, it appears that the fainter red stars are somewhat smaller, and presumably denser, than the sun, while the brighter ones are very much larger than the sun, and presumably of very small density. The latter class probably represent an early stage of evolution, and the former the latest stage that can be observed.

A standard system of photographic stellar magnitudes, Prof. E. C. Pickering. Since 1879 about two million photometric observations of one hundred thousand stars have been made at the Harvard College Observatory. The results, published in vols. l., liv., and lxx. of the "Harvard Annals," furnish a standard scale for determining the brightness of the stars in all parts of the sky, according to a uniform system. The general introduction of photography in nearly all departments of astronomy has created an urgent need for a similar scale to give the photographic magnitudes of the stars. The two scales will differ, since red or yellow stars will always give fainter images. The scale proposed will be the same for white stars as the visual scale. Three methods are adopted in this work for determining the photographic brightness—first, correcting the visual magnitude by the class of spectrum; secondly, by measuring with great care the photographic brightness of a sequence of stars near the North Pole, and superposing this photographically on the stars to be measured; thirdly, by attaching to the object-glass of the telescope a small prism, a second image of each star, five magnitudes fainter than the principal image, is formed. All three of these methods are in use on a large scale at the Harvard Observatory, and it is hoped that, as the result of many thousand measures, a satisfactory solution of the problem will be found.

Some interesting double stars, Prof. Eric Doolittle. The many thousand double stars in the sky may be divided into two classes. There are some in which the two stars are not really near each other, but merely happen to lie in the same direction as viewed from the earth, and there are others which form true systems composed of two suns revolving about their common centre of gravity. In the latter case, measures show that one sun revolves about the other in an elliptic orbit. It often happens that a very few measures of such a system secured at certain critical times throw unusual light on the nature of the motion and the size of the orbit. This is especially the case when the companion star apparently ceases its motion in one direction and begins to move backward, and also when the companion is passing nearest the principal star. Several diagrams were shown describing measures of this kind which had recently been secured. An account was also given of the discovery of a very close double star during its occultation by the moon.

THE ROYAL OBSERVATORY, GREENWICH.

READ at the annual visitation of the Board of Visitors on Saturday last, the Astronomer Royal's report of the work done at the Greenwich Observatory during the year ended May 10 contains many items of general interest.

On the transit circle the new central illumination was further compared with the annular illumination of the field, and it was found that, with the latter, transits were observed 0·24s. earlier than they are with the new form. Six stars from Newcomb's Fundamental Catalogue are observed each night in order to connect the observations of the reference stars for the Oxford Astrographic Zones with any system that may ultimately be adopted by the Permanent International Committee.

Observations of the diurnal changes of level and nadir during 1909 showed that changes of level were less, and of nadir slightly greater, than the means for 1897–1908. The lunar observations with transit circle and altazimuth are in good agreement, and, for 1908, show the mean error of the tabular place to be −0·395s. in R.A. and

0·00″ in N.P.D. The moon was observed on 146 days during the year, and observations of Mars and of Halley's comet, in and out of the meridian, were also secured.

Double stars and planetary diameters were measured with the 28-inch refractor, 150 of the pairs having separations less than 0·5″ and 296 pairs less than 1·0″.

With the 26-inch refractor 146 planetary photographs were secured, including sixty-two of Mars, taken between July 23, 1909, and May 14, for an investigation of its orbit.

Planets, satellites, and comets 1909*a*, *b*, *c* (Halley's), and *e* were also photographed with the 30-inch reflector; among these were twelve photographs of Saturn and Phœbe, thirteen of Jupiter and J. viii., and forty-four of Halley's comet. The first photograph of J. viii. during this opposition was secured on January 19, and the observed correction to the position given by the Cowell-Crommelin-Davidson orbit was only 7″; this satellite has now performed one complete revolution since its discovery. A slight elongation of the images taken with the 30-inch reflector was attributed to a small shift of the mirror cell, and has been completely eliminated by rounding the ends of the supporting screws and making hollows to receive them in the bed on which the cell rests. A 6-inch lens, kindly lent by Mr. Franklin Adams for photographing the extensions of the tail of Halley's comet, and a prismatic camera for photographing the spectrum, were attached to the 30-inch reflector, but the bright twilight and low altitude of the comet prevented the latter observations.

The work on the Greenwich astrographic zones being complete, the 13-inch astrographic refractor was employed until April for cometary and various other photographic observations. Since then it has been used for photographing the astrographic zones $+25°$ to $+31°$, originally allotted to the Oxford University Observatory. The stars on these chart plates are also to be counted at Greenwich, as are also those on the catalogue plates, which are being re-taken for the purpose. For photographing Halley's comet a new Ross lens of 4 inches aperture and 16 inches focal length has been attached to the 10-inch finder of the astrographic instrument.

Of the 3·07 days' difference between the perihelion passage of Halley's comet and the date predicted by Drs. Cowell and Crommelin, one day has been accounted for in a rediscussion of the perturbations during 1828–42, but the further discordance of two days is as yet unaccounted for by any attraction of known matter in the solar system. The observations show that none of the other elements was so much as 1′ in error.

During the period dealt with by the report the sun was photographed at Greenwich on 194 days, and the Royal Observatory contributed 171 days towards the record for 1909, which is now complete, with the assistance of the Dehra Dûn and Kodaikanal Observatories, except for two days. In this work the Cape Observatory now replaces the Royal Alfred Observatory, Mauritius, and the hope is expressed that the yearly record may be made up almost entirely from the plates taken at the two Royal Observatories, Greenwich and the Cape; during March their record was complete except for one day.

The magnetic observations were carried on as usual, but the registration of earth currents was discontinued at the end of 1909 because new wiring was found to be necessary, and was considered unjustified owing to the disturbances produced by the electric trams, &c.

For 1909 the principal magnetic results were:—

Mean declination	15° 47·6′ W.
,, horizontal force	4·0179 in British units 1·8526 ,, metric ,,
,, dip (3-inch needles) ...	66° 53′ 57″

Two days of "greater" and six days of "lesser" disturbance were registered by the magnets.

The reductions of the meteorological observations are complete to date, and show that the mean temperature of 1909 was 48·6°, 1° below the 65-year average 1841–1905. The rainfall for the year ended April 30 was 27·72 inches, 3·6 above the average, and the number of "rainy days" was 192, the highest for many years.

The performance of the chronometers tested was satisfactory, and in future non-magnetic watches are to be received and submitted to the same tests as the chronometer watches. A new trial of box chronometers commenced on June 18, and the next trial of pocket chronometers and chronometer watches will commence on July 30. The time-signal service was also satisfactory, and the performance of the Westminster clock ("Big Ben") left little to be desired. On 41 per cent. of the days its error was less than 0·5s., on 77 per cent. less than 1·0s., and on 98 per cent. less than 2·0s.; it never exceeded three seconds.

The vacancy on the *personnel* caused by the resignation of Dr. Cowell has not yet been filled, and, in closing the report, Sir William Christie tenders his hearty thanks to the staff for their loyal cooperation in the prosecution and extension of the observatory's work during his tenure of the office of Astronomer Royal. Although the work has been enormously extended during the past thirty years, the financial provision for it has been increased by only 2200*l.* per annum.

AGRICULTURAL RESEARCH.

THE need for widely extended facilities for agricultural research is being more and more recognised both by men of science and by our administrative authorities. At the last meeting of the executive committee of the British Science Guild a memorial to the Prime Minister on the subject of research in agriculture was approved. The President of the Board of Agriculture and Fisheries has now appointed a committee to advise the Board as to how agricultural research may be best encouraged and improved. Lastly, a society has been incorporated to secure the development and extension of the investigations inaugurated and endowed by the late Sir John Lawes. These are all excellent indications that a determined and united effort is to be made to place agricultural practice upon a scientific basis, and to secure for the British farmer all the help science is able to provide.

The committee appointed by Earl Carrington to advise the Board of Agriculture on all scientific questions bearing directly on the improvement of agriculture will deal especially with the methods to be adopted (*a*) for promoting agricultural research in universities and other scientific schools; (*b*) for aiding scientific workers engaged in the study of agricultural problems; and (*c*) for ensuring that new scientific discoveries are utilised for the benefit of agriculturists.

The committee will consist of the Duke of Devonshire, Lord Reay, Sir Edward Thorpe, C.B., F.R.S., Mr. David Davies, M.P., Dr. J. J. Dobbie, F.R.S. (principal of the Government Laboratories), Prof. J. B. Farmer, F.R.S., Dr. S. F. Harmer, F.R.S. (keeper of zoology at the Natural History Museum), Dr. R. Stewart MacDougall (technical adviser in zoology to the Board of Agriculture and Fisheries), Mr. T. H. Middleton (one of the assistant-secretaries to the Board of Agriculture and Fisheries), Mr. Spencer P. Pickering, F.R.S., Lieut.-Colonel David Prain, C.I.E., F.R.S. (director of the Royal Botanic Gardens, Kew), Mr. H. S. Staveley-Hill, M.P., Mr. Stewart Stockman (chief veterinary officer of the Board of Agriculture and Fisheries), Dr. J. J. H. Teall, F.R.S. (director of the Geological Survey and Museum), and Dr. David Wilson. Mr. Middleton will act as chairman of the committee, and one of the officers of the Intelligence Division of the Board will act as secretary.

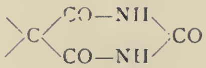
A meeting of the Society for Extending the Rothamsted Experiments was held at Rothamsted on June 16 under the presidency of the Duke of Devonshire. The society has been incorporated with the object of obtaining additional funds for the development of the agricultural investigations which have been carried on so long under the late Sir John Lawes and the Lawes Agricultural Trust which he afterwards founded. The immediate object of the society is to obtain a sum of 5000*l.* in order to secure about 200 acres of land adjoining the present experimental fields, and erect thereon the buildings required for feeding experiments with the crops under investigation.

An appeal for subscriptions towards thus securing a small self-contained farm for the Rothamsted Experimental Station is now being circulated, and at this meeting of the society a first list of donations was reported from the Duke of Devonshire, Lord Iveagh, Sir J. T. Brunner, Colonel E. H. Carlile, M.P., Mr. J. F. Mason, M.P., and Mr. J. Martin White, amounting to 1450*l.*

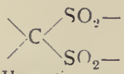
CHEMISTRY AND PHARMACO-THERAPEUTICS.

THE Hurter memorial lecture was delivered recently before the Liverpool Section of the Society of Chemical Industry, by Dr. C. A. Keane, on modern iatrochemistry (Journal of the Society of Chemical Industry, Liverpool Section, April 15). Dr. Keane traced the development of various synthetic products used in pharmacy, and discussed the relations of physiological properties to structure so far as they may be said to be known. He illustrated his discourse by three typical groups of compounds—the antipyretics derived from *p*-aminophenol, the hypnotics derived from malonyl urea, and the local anæsthetics related to cocaine. Referring to the first group, he showed that the toxic properties of aminophenol may be reduced and its antipyretic action increased by introducing radicals into the hydroxyl and amino groups. He pointed out the importance of a sufficiently stable combination to resist decomposition by the acid of the gastric juice, as otherwise the radical is split off in the stomach with the production of the parent substance. The practical outcome of these investigations has led to the recognition of phenacetin as the most suitable for medicinal use.

Among the substitutes for salicylic acid as an anti-rheumatic he mentioned salol (phenyl ester), aspirin (acetyl salicylic acid), and salophen (salicyl acetaminophenol), substances which, being stable towards acid, pass through the stomach unchanged, but are subsequently hydrolysed by the alkaline pancreatic juice, when the constituents begin to exert their specific effect. Passing on to the hypnotics, veronal and sulphonal and their analogues, it was observed that each contains a hypnotic group in which alkyl radicals (R, one of which must be ethyl) are necessary to produce hypnotic action.



Hypnotic group



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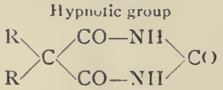

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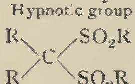

Hypnotic

Dr. Keane then gave an account of cocaine, the nature of the groups which are responsible for local anæsthesis, and the successful application of this knowledge to the production of new drugs, such as α and β eucaine, orthoform, stovaine, novocaine, holocaine, &c.

The address concluded with a table of statistics giving the quantity of synthetic drugs imported from Germany (the seat of the industry) to this country, which on six drugs alone amounts to about 20 tons, of the value of 16,000*l.* annually.

THE BEGINNINGS OF HUMAN SPEECH.

AN interesting attempt by Dr. C. Täuber to trace human speech back to its first beginnings appears in *Globus* for May 12 (Bd. xcvii.). For this purpose the writer classifies the simplest conceptions and the sounds representing them into six divisions, as follows:—(i.) *m*+vowel, meaning liquid food (*e.g.* milk, melt, Germ. Ge-müse, &c.); (ii.) *p* (*b* or *v*)+vowel, solid food (*e.g.* bread, Germ. Futter, Lat. panis, &c.); (iii.) *n*+vowel, sometimes *sn*, fluidity (*e.g.* Lat. navis, Germ. nass, snow, &c.); (iv.) dental+vowel, sometimes *st*, wood or forest (*e.g.* timber, Germ. Stuhl, throne, Germ. Tanne, &c.); (v.) liquid+vowel, feeding or drinking place (*e.g.* Gk. libadion, lake, Germ. Loch, &c.); (vi.) guttural+vowel, animal world (cow, Lat. caper, Germ. Hund, &c.).

For each division Dr. Täuber draws up a table of derived ideas represented by the same root-syllable in various Indo-Germanic languages, *e.g.* under (i.) we find Mama, Germ. Mutter on one side and Germ. Meer, Lat. mare, &c., on the other. From mater, mother, is derived the idea of to feed, and from that, again, the conception well-fed, large. It must be confessed that considerable ingenuity is required to trace the connection in some instances, but the author freely owns to setting forth speculative results. It is extremely interesting to note that these six sound-groups appear *with the same force* in many non-Indo-Germanic languages; for instance, (i.) *m*+vowel in Hebrew manna (food), māim (water), mātār (rain), māhal (wine mixed with water); in Bantu languages *ma*=water occurs very frequently in compound words; also in Chinese (in Siamese n-am); in the form *mu* in the Ural-Altaic languages (Tungus and Manchurian mu-ke=water, Japanese u-mi=sea, a-me=rain); ma, meaning water, rain, or drink, is widespread in the Australian, Polynesian, and Malay languages; the Eskimo have the word muk for water. The derived conception mag=large occurs in Caucasic, Ural-Altaic, and Dravidian languages. Instances from Semitic, Caucasic, and other languages are also given for the other five sound-categories. Dr. Täuber would like to see his scheme worked out and amplified and the *Ursprache* established beyond question, after which it might be possible to ascertain the points at which the great linguistic branches differentiated.

ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

THE annual conference of the Association of Teachers in Technical Institutions was held at Birmingham in the Birmingham Municipal Technical School on Friday and Saturday, June 17 and 18. In his address, the president of the association, Mr. J. Wilson, Battersea Polytechnic, emphasised the importance of scientific and technical education to industrial progress. As an example of this, it was pointed out that, owing largely to the limited appreciation of technical education by the English manufacturing world as a whole, nearly all the chief industrial developments of the last twenty years are either of German, French, or American origin or commercial development. The present national and municipal expenditure on technical education in Great Britain is approximately one and a half millions sterling per annum. This is very small when compared with the "gross" annual output of the engineering and chemical industries alone, amounting to about 258 millions per annum. Mr. Wilson discussed the position of the London polytechnics with reference to the London University. He considered that any diminution in the effective facilities now offered by the polytechnics to the working and lower middle classes to participate, not only in advanced technical education, but in higher and university education, would be a grave retrograde step.

In a paper read at the afternoon session by Dr. Price, of the Birmingham Technical School, on "The relation between the technical school and the university," it was pointed out that, generally speaking, the average technical student, however highly qualified he may be by previous study and experience, cannot possibly attend the university, owing to the high fees and cost of maintenance. In reply to certain criticisms by Prof. Meldola and Sir William Ramsay on the value of evening instruction, it was stated that at the present time many evening students in technical institutions are taking courses in the highest branches of technical knowledge, with advantage to themselves and to the industry with which they are connected. In Birmingham, for instance, there are men holding responsible positions who have received all their scientific training in the evening classes at the technical school. Many drawbacks in the highly valuable system of external examinations of the London University could be obviated if a satisfactory system could be devised by means of which technical institutions of sufficient standing could be affiliated to the local universities. Many of the larger technical schools are well equipped and have a highly trained staff which is able to, and does, carry out research.

A number of general resolutions on technical education were passed dealing with subjects such as:—(*a*) the co-ordination of education in the primary, secondary, and continuation schools with technical school work; (*b*) the necessity for the provision of technical education of a more advanced and more highly specialised character than exists at present; (*c*) technical schools to be allowed to develop their work as highly as local requirements demand; (*d*) urging upon the Government the desirability of appointing a Royal Commission to inquire into the need for the organisation of technical education throughout the country.

KEW AND ESKDALE MUIR OBSERVATORIES AND THE METEOROLOGICAL OFFICE.

BY arrangements recently concluded between the Lords Commissioners of H.M. Treasury, the Royal Society, the National Physical Laboratory, and the Meteorological Office, the administration of the work of the Kew Observatory, in so far as it is concerned with observational and experimental work in meteorology and geophysics, will be transferred to the Meteorological Office as from July 1. The Kew Observatory will be the central observatory for the office. All communications respecting that side of the work of the observatory should thenceforth be addressed to the director of the Meteorological Office, Kew Observatory, Richmond, Surrey.

By another provision of the arrangement the administration of the observatory at Eskdale Muir will be associated by the Royal Society with the Meteorological Office instead of, as heretofore, with the National Physical Laboratory.

In the conduct of the administration of the observatories the director of the Meteorological Office will have the assistance of an advisory committee—the Gassiot Committee, appointed by the Royal Society to administer the funds of the Gassiot Trust, representing an endowment of 10,000*l*. vested in the Royal Society in 1871 by Mr. J. P. Gassiot.

One of the provisions of the new scheme is that the superintendents of the three observatories—Kew, Eskdale Muir, and Valencia—under the direction of the Meteorological Office shall be appointed by the Meteorological Committee upon the nomination of the Gassiot Committee. On this nomination the appointments of Dr. C. Chree, F.R.S., as superintendent of the Central Observatory, and of Mr. G. W. Walker, of Eskdale Muir Observatory, have been continued by the Meteorological Committee. Dr. Chree has further been appointed assistant-director of observatories for the Meteorological Office. Mr. J. E. Cullum remains superintendent of Valencia Observatory.

The work of testing instruments now carried on at Kew Observatory by the National Physical Laboratory will be removed to Teddington as soon as the necessary provision for its transference can be made. The laboratory will retain the well-known K.O. mark for use with those classes of instruments which have hitherto been tested at the observatory. For the time being the work will be carried on at the observatory as a department separate from the observational work, but under the superintendence of Dr. Chree. Communications respecting this side of the work should be addressed to the director of the National Physical Laboratory, Observatory Department, Richmond, Surrey.

INDUSTRIAL WORK AND EDUCATIONAL DEVELOPMENT.[1]

LOCAL authorities have tried in various ways to secure in their work for further education the cooperation of employers of labour in their areas. Under present industrial and educational conditions, great importance attaches to any action taken by employers either in increasing their employees' opportunities for attending technical classes or in urging, and granting practical recognition to, the gain which systematic study in such classes brings to workmen who attend them. In 1905 the Board prepared a circular describing some of the more fruitful efforts which had been made in securing the co-operation of employers in these and similar ways, and the issue of this circular stimulated further efforts of the kind in various parts of the country. It is now generally recognised that one of the duties of managers of technical schools is to establish and maintain the closest possible relations with those under whom their students are employed.

The development and strengthening of the relation which the work of the teaching institution bears to the practice and to the commercial aspects of industries may do much to promote industrial progress, and it is not unreasonable to expect that in making their arrangements with their younger workpeople employers should give some consideration to the conditions necessary for the work of the school. Individual employers and groups of employers have in practice found it compatible with economy of production in trade workshops to allow some reduction in the ordinary working time to those of their employees who attend approved courses of instruction in technical schools. The usual combination of workshop and school in the preparation for industrial work assigns the evening only to school, and requires the young worker during the day to give full-time attendance in the workshop. It is true that even in these conditions large numbers of students have made great progress in their technical education. For students of energy, strength, and ability evening classes have afforded, and still afford, opportunities of advancement in knowledge which, when coupled with the experience of practical work, of men, and of commercial conditions which they acquire in their daily occupations, enables them to qualify for positions of responsibility in the industries. Evening classes have indeed provided an open avenue for talent—an avenue by which not a few have advanced to positions in which they have done marked service for the industrial welfare of the country. Where, however, studies have to be carried on in evening classes alone, they are subject to difficulties which in all cases retard the student, and in many cases dishearten him before he has obtained even such knowledge of principles as he requires if he is to be an intelligent hand-worker. The movement towards an extension of the opportunities for part-time study during the day is therefore one which may have far-reaching results.

The forms in which additional facilities for school work are afforded differ considerably; the main cause of this variety of form is that the conditions of different trades vary considerably both as to the nature of the part taken in the work by young workmen and as to the continuity of the demand for work throughout the year.

There are now, however, in successful operation courses of part-time study under arrangements involving time off from the works for such periods as one or two afternoons a week, one day a week, three days a week, or, it may be, daily during two months of a slack period of the year. In all cases of this kind the authorities of the local technical school arrange courses of instruction for the hours available, and that instruction is definitely related to the requirements of the groups of students in attendance. Under these conditions the students have the advantages of class instruction in the daytime, and they can without strain supplement this by home-work in the evenings, and yet have time throughout the year for other interests. Part-time study in the day in this way has been proved possible and of much advantage in connection with engineering and building trades, with painters' work, with plumbers' work, and other trades.

Coupled with schemes of this kind, as well as in connection with the ordinary evening-school system, there have been established in many places scholarships or other facilities by which promising students may devote longer periods entirely to study—periods in some cases six months, in others one, two, or even three years.

There can be no doubt that the increase of day classes for part-time students will do much to advance technical education. Such an increase would not be costly, for in most towns there have now been provided technical schools on a scale commensurate with the demand for specialised technical instruction in the evening, and during the day these schools are generally but little utilised. The extension of such day work gives occasion for a better division of the time of technical teachers, and thus makes it possible for school authorities to obtain greater value for their expenditure in retaining the services of well-qualified teachers.

The possibilities involved in even a slight re-distribution of the hours young people devote to work and to instruction, respectively, are so important that it is of special value to have good tests of what can be attained in this way in actual practice without disturbance of economic conditions. The arrangements made in connection with day classes recognised under the Board's regulations afford numerous examples of methods by which employers of labour and local education authorities have been able to work together in providing special classes adapted to a particular trade or industry and to local conditions of

[1] From the Report of the Board of Education for the Year 1908–9. [Cd. 5130.] Price 9½*d*.

employment, and details of some such instances of part-time day work may be indicated here.

In a town in the north of England a number of apprentices are set free from their employment at certain times so that they may attend classes which have been specially arranged for them in the local technical school in engineering and allied trades; the courses extend over two sessions of eight months each; students in their first year attend for one morning and one afternoon a week, and those in their second year for two afternoons a week, or four hours in all. The fees are paid by the employers; the apprentices pay for books and materials, but receive their wages for the periods of absence from work granted to enable them to attend the classes. The time spent by apprentices in attendance at the day classes is counted in their term of apprenticeship, and preference is given by the employers in filling vacancies in their works to those who attend the classes. The employers are represented on the governing body of the technical school.

The local education authority at a railway centre in the south of England has provided in the technical institute classes for engineering apprentices in the employment of the railway company. The apprentices are allowed to attend a four years' course, arranged in the case of the first year of instruction for 2½ hours for one morning a week, and in the case of the second and third and fourth years for 3½ hours a week, spread over two mornings. Again, at a railway centre in the north of England, the technical school carries on a course on the construction and management of the locomotive to meet the requirements of engine drivers, firemen, and engine cleaners; the instruction here is for two hours on one morning a week, and is given by teachers who are district locomotive foremen.

In a centre of chemical manufacture we find special arrangements for the instruction of trade apprentices of large engineering and chemical works. In the case of one firm the employers require that their employees shall attend an evening school until they are nineteen years of age, but some of the apprentices of this and of another firm are allowed to attend for instruction for four hours on two afternoons a week for forty weeks in the year during the last two years of their apprenticeship, without loss of wages during their absence from the works at the classes; the employers pay the fees, and attendance at these classes is regarded by them as a very important part of the apprenticeship.

In a large industrial centre the local education authority has provided apprentice day courses for engineering, plumbers' work, and painters' and decorators' work; the various courses range over two or more years, and meet for one whole day a week throughout the year. Seasonal periods of less pressure or slackness of work are peculiarly liable to occur in summer in some departments of the building trade, such as painting and plumbing, and accordingly the same authority has succeeded in establishing a suitable special summer course for plumbers who can utilise the opportunity in order to improve their knowledge and efficiency by attending on four full days and two half days weekly throughout a complete month for instruction in subjects cognate to plumbing.

Again, in the case of a closely related trade (gas-fitting), where, however, the conditions of work are somewhat different, another local authority has arranged that boys who are under training to become gas-fitters may have the advantage of concurrent technical education in the day-time. The boys attend at the local technical institute for three hours on each of three afternoons a week. The instruction they receive is in continuation and development of their previous work at the public elementary school, and includes English, workshop arithmetic, and mechanical drawing.

Among the advantages of close relations between school authorities and the employers of the students who attend the schools, not the least is the increased confidence with which school authorities can advise their pupils—especially young pupils—as to the studies they ought to take up. In the arrangements made for giving such advice there is room for great improvement; at present it is not possible to say more than that this is an essential feature in all schemes of evening-school work that succeed in securing large and continued attendance of pupils.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following are the speeches delivered by the Public Orator, Dr. Sandys, on Tuesday, June 14, in presenting Sir Oliver Lodge, principal of the University of Birmingham, and Prof. William Henry Perkin, professor of organic chemistry in the Victoria University of Manchester, for the degree of Doctor in Science *honoris causa*:—

Adest vir scientiarum physicarum in regione quadam caelesti investiganda iam per annos triginta praeclare meritus, qui praesertim aethera illum exploravit, per quem solis stellarumque lux et calor "immemorabile per spatium" confestim, sine ullo phaenomenorum terrestrium impedimento, in orbem terrarum nostrum transmittuntur. Idem diligenter inquisivit, fulgurum vis electrica quomodo fila tectorum securitati inservientia percurrat, quamobrem subito deserat. Inde progressus, etiam vim electricam, non aliter quam lucem, undarum more moveri eo ipso tempore argumentis idoneis ostendebat, quo vir quidam insignis, Henricus Hertzius, illud ipsum experimentis comprobavit et Maxwellii nostri vaticinationes veras esse demonstravit. Iure igitur optimo Regia Scientiarum Societas numisma lucis et caloris legibus investigandis propositum huic potissimum viro donavit; iure optimo nos quoque, et haec et alia eius merita plurima admirati, eundem inter scientiarum doctores nostros honoris causa collocamus. Eum certe, qui Anglia in media, ipsius Volcani in domo dilecta Sapientiae sedem serenam nascentem fovit, crescentem adiuvit, etiam nostra Mater Alma voltu benigno respicit.

Praesentatur vobis Universitatis illius novae praeses dignissimus, rerum naturae explorator felix, eques insignis, Oliver Lodge.

Abhinc annos quattuor et quinquaginta unus e nostratibus (iuvat gloriari) primus omnium indicavit etiam e liquore piceo, qui carbonis fossilis e bitumine exsudat, colores quosdam roseos posse exoriri. Utinam etiam inventi tam pulchri repertorem illustrem purpura nostra decorare nobis contigisset! Laetamur tamen patris tam illustris in filio insigni eandem laboris patientiam, eundem scientiae, eundem veritatis amorem simplicem sincerumque agnoscere. Vir in experimentis elaborandis sollertissimus, in experimentorum interpretatione perspicacissimus, (ne plura commemorem) non modo "narcotinam" illam, quae papaveris in suco est, sed etiam rerum naturae odores quosdam suavissimos artificio suo aemulatus est. Viro tali idcirco praesertim gratulamur quod ei, propter labores eius assiduos, primum a Societate Regia Londiniensi numisma aureum donatum est; deinde Victoriana in Universitate Mancuniensi, viri huius e studiis novam gloriam adeptae, cathedra nova constituta. Laetamur denique tot colorum inventoris filium, in eadem scientiarum provincia exploratorem felicem, honoris causa purpura nostra vestitum videre.

Duco ad vos scientiae chemicae professorem Mancuniensem, nominis magni heredem magnum, Willelmum Henricum Perkin.

LEEDS.—At a meeting of the council of the University held on June 15, the following resolution was passed:—"The council record their deep sense of the honour done to the University by the offer of a fund raised as a memorial to the late Sir George Livesey for the endowment of a professorship of applied chemistry relating to the coal-gas and fuel industries. The council gratefully accept the offer, and hereby establish a Livesey professorship of coal-gas and fuel industries, subject to the conditions prescribed in the deed of gift submitted on behalf of the donors or the Livesey Memorial Fund." The fund referred to amounts to about 11,000*l.*, and has been collected from corporations, companies, and private donors associated with the industries with which Sir George Livesey was so honourably connected.

LONDON.—At a meeting held on June 15 the Senate re-elected Dr. M. J. M. Hill, F.R.S., Astor professor of mathematics, to be Vice-Chancellor of the University for a second term of office, viz. until June, 1911.

OXFORD.—The electrical laboratory presented to the University by the Drapers' Company, and erected on the north side of the University Museum at a cost of 23,000*l.*,

was opened in the presence of a large company on June 21. The Master of the Drapers' Company, Mr. K. R. Fletcher (upon whom the degree of Doctor of Civil Law *honoris causa* was conferred), made the presentation of the laboratory, and the Chancellor (Lord Curzon) acknowledged the gift in a speech, in the course of which he said that eight years ago, when a statement was drawn up of the needs of the University, a very prominent place was given in it to the need for a laboratory for the Wykeham professor of physics, and only three years ago, when the Vice-Chancellor and he wrote their first letter to the Press on behalf of the appeal for the re-endowment of the University, they summed up the requirements of the University in this respect in the laconic phrase, 'We need an electrical laboratory.' Oxford needed it, not merely to enable the professor to give the best teaching to candidates for honour degrees, but also to enable him to keep in touch with the most modern scientific discovery by the pursuit of independent research with the aid of the most recent appliances, and also, of course, to provide opportunities for similar investigations to outside people. He would not, however, like anyone to go away with the idea that, even after this splendid gift, the scientific requirements of the University were exhausted. The department of chemistry, both in respect of teachers and of laboratories, was quite unfit for the great institution to which it belonged. He was sure, also, that in the department of engineering science a laboratory was badly wanted.

COLUMBIA UNIVERSITY has conferred its doctorate of science on Sir William White, K.C.B., F.R.S.

IT is announced in *Science* that Bryn Mawr College has obtained money sufficient to pay its debts, and in addition 50,000*l*., which entitles it to the appropriation of 50,000*l*. of the General Education Board. The sum raised by the Alumnæ Association was 60,800*l*., which is to be used for the endowment of chairs in mathematics, English, and economics.

THE Imperial University Congress, which will be held in London in 1912, is likely to be one of great importance and of far-reaching influence. All the universities of the Empire are to be invited to send representatives to the congress, and the invitations are being issued in the names of the Universities of London, Oxford, and Cambridge, while the University of London will have the duty of organising the congress. It has been suggested that a preliminary meeting of representatives of British universities might be held next year with the view of preparing materials for the congress. Dr. R. D. Roberts, formerly Fellow of Clare College, Cambridge, and one of the registrars of the University of London, will act as secretary of the congress.

As announced already, the third International Congress on School Hygiene is to be held in Paris on August 2–7 next. The organising committee of Great Britain and Ireland, of which Sir Lauder Brunton, Bart., F.R.S., is president, is appealing specially to all who were associated with the London congress in 1907 to attend the Paris meeting. Travelling and hotel accommodation are being arranged by the committee at moderate charges, and full particulars concerning them can be obtained from Mr. Durrie Mulford, assistant secretary, 90 Buckingham Palace Road, S.W. The general meetings of the congress will deal with uniformity of method for physical examinations in schools, sexual education, and the training and appointment of the school doctor. The other business of the congress will be done in eleven sections, dealing with every aspect of the question of securing the health of the teachers and pupils in schools.

THE Johns Hopkins University Register, 1909–10, which has reached us from Baltimore, contains an interesting historical statement. From this we find that the original endowment of the University amounted to a little more than 600,000*l*. This sum has been supplemented by several gifts, including the endowment fund of 1902, amounting to 200,000*l*., and the John W. McCoy fund of 100,000*l*. The income-bearing funds have a "book value" of 916,000*l*. The real estate and buildings, books, scientific apparatus, and general equipment are valued at 380,000*l*. The total value of the assets of the University is thus about 1,300,000*l*. In June, 1909, the General Education Board offered to contribute 50,000*l*. towards the endowment of the University provided the institution is able to secure 150,000*l*. on or before December 31 next. It is expected that the conditions of the gift will be met by the date specified. The Legislature of Maryland recently made an appropriation of 5000*l*. a year for 1911 and 1912.

WE have received a copy of a syllabus for the "teaching of science of home affairs," drawn up by a committee of the Association of Teachers of Domestic Science, in conjunction with certain teachers of chemistry and hygiene. The object of the syllabus is to indicate a course of instruction up to a "matriculation" or "school-leaving" standard suitable for girls in a secondary school. The course is designed to include those portions of elementary physics, chemistry, hygiene, and physiology necessary for the proper understanding of the scientific principles underlying home management. It is hoped that courses, somewhat on the lines of those suggested in the syllabus, will in the future be generally adopted in girls' secondary schools, thereby bringing about a much needed correlation of the science teaching with the instruction in cookery work, laundry work, &c. The committee suggests the desirability of the inclusion of this modified science course as one of the optional subjects for girls in the scheme of examinations held by the authorities now conducting public examinations of a "matriculation" or "school-leaving" standard.

THE Royal Commission on University Education in London has issued its first report, which consists of the minutes of evidence taken up to April, 1910. It will be remembered that the commissioners were appointed to inquire into the working of the present organisation of the University of London, and into other facilities for advanced education (general, professional, and technical) existing in London for persons of either sex above secondary-school age; to consider what provision should exist in the metropolis for university teaching and research; to make recommendations as to the relations which should in consequence subsist between the University of London, the incorporated colleges, the Imperial College of Science and Technology, the other schools of the University, and the various public institutions and bodies concerned; and, further, to recommend as to any changes of constitution and organisation which appear desirable, regard being had to the facilities for education and research which the metropolis should afford for specialists and advanced students in connection with the provision existing in other parts of the United Kingdom and of our dominions beyond the seas. In a letter to the *Times* of June 17, Prof. M. J. M. Hill, Vice-Chancellor of the University of London, points out that, in addition to the evidence already published, further evidence from persons representing other views held in the University will be submitted to the Royal Commission, and suggests that it would be well to suspend judgment and to abstain from drawing conclusions from the evidence now available until the whole inquiry has been completed and the commission has issued its final report.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 16.—Sir Archibald Geikie, K.C.B., president, in the chair.—D. **Thoday**: Experimental researches on vegetable assimilation and respiration. VI.—Some experiments on assimilation in the open air. In these experiments Sachs's half-leaf dry-weight method has been employed, with modifications suggested in a previous paper for avoiding errors due to shrinkage of the insolated half-leaves. Turgid leaves of *Helianthus annuus* were found in bright sunlight to increase in dry weight 17 mg. per hour per sq. decim.; thus Sachs's high value is confirmed. Even a slight loss of turgor, however, was accompanied by a diminution in the rate of increase. For this high rate of assimilation a leaf-temperature of 23° C. to 24° C. is probably required. It is suggested that Brown and Escombe's low results in bright diffuse light indicate that the stomata of Helianthus leaves open to their full extent only in light which is similar in quality to sunlight and approaches it in intensity. Detached leaves of

Catalpa bignonioides when fully turgid increased 5–6 mg. per hour per sq. decim. in bright sunlight; in this plant stomata occur only on the underside of the leaf. The effect of detachment from the plant upon the rate of assimilation is considered, and evidence is adduced in support of Sachs's assumption, in the case of *H. annuus*, that, concurrently with assimilation, part of the products of photosynthesis are translocated from leaves still attached to the plant.—Prof. Ronald **Ross** and D. **Thomson**: A case of sleeping sickness studied by precise enumerative methods; regular periodical increase of the parasites disclosed. The enumerative methods referred to consist of modes of detecting blood parasites when very scanty, and of counting them accurately. The methods have been applied to a case of sleeping sickness in the clinic of Prof. Ross in Liverpool for seventy-three days continuously, and have shown that the numbers of *T. gambiense* in this patient's blood undergo remarkable periodical variations about every seven to eight days. The authors state that, so far as they can ascertain, though the numbers of trypanosomes had been known previously to vary from time to time, the regular periodicity revealed in their case appears to have been overlooked, possibly owing to insufficient methods of counting. The authors report that numerous parallel researches are being conducted, and give a chart.—Dr. C. **Todd** and R. G. **White**: The recognition of the individual by hæmolytic methods (preliminary communication). (1) The immunisation of the ox with the red blood corpuscles of other oxen gives rise to the formation of a hæmolytic amboceptor in the blood of the immunised animals. (2) The amboceptor so formed is an *isolysin*, but not on *autolysin*. (3) The race of the animal appears to have very little influence on the resulting hæmolysins. (4) The serum of an animal so treated acts very differently on the red blood corpuscles of different individual oxen. (5) The sera of different individuals similarly immunised differ from one another in their action on the corpuscles of different individuals. (6) If the serum of a single immunised animal be "exhausted" with excess of the corpuscles of one other individual, the serum loses its power of hæmolysing the corpuscles of this individual, while retaining the power of hæmolysing the corpuscles of many, but not all, other individuals. (7) If, however, a polyvalent serum be made by mixing the sera of a large number of immunised animals, and this serum is exhausted with the corpuscles of any one individual, the serum entirely loses its power of hæmolysing the corpuscles of this individual, but remains strongly hæmolytic for all other individuals not closely related to the individual the corpuscles of which were employed for the exhaustion of the serum. (N.B.—It is possible that exceptions may be found, but these have not yet been met with, except in the case of close blood-relations.) (8) The red blood corpuscles of any individual are thus characterised by a definite individuality of their own, and can be distinguished from those of any other individual of the same species.—F. M. **Tozer** and Prof. C. S. **Sherrington**: Receptors and afferents of the third, fourth, and sixth cranial nerves. Examination of the several extrinsic muscles of the eyeball in the monkey, cat, and rabbit, shows that these muscles contain, besides nerve-endings of the motor kind, large numbers of receptive (sensorial) nerve-endings, both in the fleshy part of the muscles and in the tendons. Investigation of these by experimental methods shows that all the receptive end-organs, as well as the motor endings, derive their nerve-fibres from the third, fourth, and sixth nerve-pairs respectively. These cranial nerves are therefore not purely motor, as generally supposed, but are sensory as well as motor. The number of afferent nerve-fibres they contain is very considerable. In addition to their sensory and motor supply from third, fourth, and sixth nerves, these muscles and their tendons receive a small supply of nerve-fibres from the ciliary ganglion. This ciliary-ganglion supply is largely, if not wholly, vasomotor in function, and no evidence was found that it is in any way sensorial. Nor does the fifth cranial nerve supply any sensory nerve-fibres to these extrinsic eye muscles. The afferent divisions of the third, fourth, and sixth cranial nerves are entirely proprioceptive in function; the receptive organs they subserve are entirely proprioceptive.—Sir David **Bruce**, Captains A. E. **Hamerton** and H. R. **Bateman**, and Captain F. P. **Mackie** (Sleeping Sickness Commission of the Royal Society, 1908–9): (i.) Trypanosome diseases of domestic animals in Uganda, I. (ii.) Experiments to ascertain if cattle may act as a reservoir of the virus of sleeping sickness (*Trypanosoma gambiense*). (i.) The commonest trypanosome disease among cattle in Uganda is caused by a trypanosome of the *dimorphon* type, which is probably similar to that sent from the west coast by Dutton and Todd under the name of *T. dimorphon*, and described by Laveran and Mesnil, and Thomas and Breinl. It seems now that probably Dutton and Todd's *T. dimorphon* is quite different from that which they sent to Liverpool under that name. The original strain of *T. dimorphon* described by them had well-marked dimorphic characters, whereas the trypanosome sent to Liverpool was monomorphic. There is some evidence forthcoming that the *T. dimorphon*, as described by Dutton and Todd, really exists, and has been described as occurring in north-west Rhodesia by Montgomery and Kinghorn, and also on the west coast. In these circumstances it seems better to give the monomorphic form, which has up to the present been known by the name of *T. dimorphon*, a new name. It is a small trypanosome, short and stout in form, averaging 13·2 microns in length, with a maximum of 16·0 and a minimum of 10·6. It has no free flagellum, and is restricted in its movements. The conclusions are that:—(1) there is an important trypanosome disease of domestic animals in Uganda; (2) the trypanosome is similar in morphology, action on animals, and cultural characters, to *T. dimorphon*, as described by Laveran and Mesnil and to Dr. Edington's trypanosome from Zanzibar, except that this trypanosome is not pathogenic to guinea-pigs; (3) the carrier is unknown, but is probably a Tabanus, possibly a Glossina, and improbably a Stomoxys.—Clement **Reid** and E. M. **Reid**: The lignite of Bovey Tracey. In 1863 Heer and Pengelly published in the Philosophical Transactions an account of these lignite beds and their flora. Heer classed the lignite as Lower Miocene, considering it equivalent to the Aquitanian of France and to the Hampstead beds of the Isle of Wight. These latter are now referred to the Middle Oligocene. A statement by Starkie Gardner, that Heer's Bovey plants are the same as those found in the Bournemouth beds (Middle Eocene), has caused the Bovey beds to be classed as Eocene in recent text-books and on recent maps of the Geological Survey, leaving a great gap in the geological record in Britain. The authors' researches have not supported this view, but tend to show that Heer was right, the Bovey lignite being highest Oligocene, or perhaps lowest Miocene. The authors made a collection in the Bovey deposits, so far as the state of the lignite pit would allow, in order to settle, if possible, the true age. The results were unexpected, for, by using new methods, they obtained a considerable number of species, mainly identical with well-known plants of the lignite of the Wetterau, which is generally classed as Upper Oligocene. In certain cases better specimens showed also that Heer's supposed peculiar species of Bovey belong to well-known forms of the Rhine lignite, his *Vitis britannica*, for instance, being only a crushed seed of *Vitis teutonica*. Several curious new species were discovered, including the earliest known Rubus, a peculiar Potamogeton, and a new genus of Boragineæ. A study of the cone and leaf of *Sequoia couttsiae* proves that it is a true Sequoia, and not a species of Athrotaxis.

Mineralogical Society, June 7.—Prof. W. J. Lewis, F.R.S., president, in the chair.—A. **Russell**: The occurrence of phenakite in Cornwall. Phenakite was unknown in the British Isles until the discovery by the author in 1905 of a single specimen at the Cheesewring Quarry, Linkinhorne, Cornwall. In 1906 he collected further specimens showing numerous small, but well-formed, crystals from a tin lode at South Phœnix Mine, Linkinhorne. In an old Cornish collection acquired by him in 1909 he found a specimen with as many as forty fine crystals; it was labelled "Topaz on Quartz from St. Agnes." Phenakite was also recognised on a specimen found about the year 1870 by Mr. J. H. Collins at South Crofty Mine, Illogan, Cornwall. Search at the Natural History Museum and the Museum of Practical Geology brought to light other specimens of phenakite placed under apatite.—Dr. G. F. H.

nith: (1) Phacolite from near Belfast. Two types were scribed. In the first the crystals were large (about –14 mm. across) and much striated, and in the second ey were small (about 1–2 mm. across), but with plane ces; in both instances the crystals were twinned about e trigonal axis, the individuals interpenetrating one other, and the forms present were $r(10\bar{1}1)$, $t(3\bar{1}42)$, $(01\bar{1}2)$, $s(02\bar{2}1)$. The measurements accord closely with e data given for chabazite. (2) The crystalline form of trogen sulphide. Crystals of this rare substance have cently been prepared by Mr. F. P. Burt, University ollege, London, by sublimation. The constants obtained ere $a:b:c=0{\cdot}8879:10{\cdot}8480:\beta=90^{\circ}\ 23'$, and the observed rms were (100), (010), (001), (110), $(\bar{1}01)$, (011), (101), 10), (111), $(\bar{1}21)$, the last four being new. The crystals ere invariably characterised by polysynthetic twinning oout $(\bar{1}01)$. A biaxial interference figure with strong posive double refraction was visible through $(\bar{1}01)$.—Dr. G. T. rior and Dr. G. F. H. **Smith**: A new arsenate and hosphate of lime and strontia from the Indian manganese eposits. Chemical analysis showed that the mineral pproximates to the arsenic analogue of apatite. The ystals were not well formed, but the physical characters, o far as they could be determined, accord with those of patite. The name fermorite, after Dr. L. L. Fermor, of ne Geological Survey of India, who has made an xhaustive study of the manganese deposits, is proposed for nis analogue. The presence of strontium, which has not et been detected in apatite, is of interest.—L. J. **Spencer**: (fifth) list of new mineral names.

Royal Meteorological Society, June 15.—Mr. H. Mellish, president, in the chair.—J. I. **Craig**: England, Abyssinia, the South Atlantic; a meteorological triangle. The idea that there may be an organic connection between the annual or seasonal total of rainfall in western Europe and the amount of the Nile flood is no new one, for in 1882 Prof. Balfour Stewart gave reasons for claiming such a connection between the flood of the Nile and the flow in the Thames. More recently Colonel H. E. Rawson has indicated a connection between the weather in South Africa and that in Africa north of the equator, and in particular the Nile flood. Dr. G. T. Walker has found a connection between the monsoon rainfall in India and pressure six months previously in Argentina, and Sir Norman and Dr. W. J. S. Lockyer have proved the existence of an inverse barometric relationship between India and Argentina. Dr. W. N. Shaw has also directed attention to certain correspondences between the velocity of the wind at St. Helena and the intensity of rainfall in the south of England, and pointed out that in the steady current of the south-east trade wind we may expect to find evidence of the throbbing of the aërial pulse consequent on the greater or smaller supply of solar radiation that reaches the earth and is transformed into kinetic energy. Within the last few years an organised meteorological service has been started in Egypt, and the results obtained therefrom have enabled Mr. Craig to carry out this investigation more closely. He finds that there is a distinct tendency for the south-east trade wind of the South Atlantic to divide into two branches, the first continuing the general northward movement, and the second turning to the right and moving across into the interior of Africa. He concludes that the moisture for the Nile flood comes from the South Atlantic, and that an increase in the velocity of the current will show itself in a proportional increase of the flood. There are too many gaps in the velocity records for the summer months to allow of a statistical test being applied, but it is not improbable that an intensification of the Transafrican current is connected with a similar intensification of the south-east trade wind of the Atlantic, which, as Dr. Shaw has shown, is not improbably connected with an increase of rainfall in the south of England.

DUBLIN.

Royal Irish Academy, June 13.—Dr. F. A. Tarleton, president, in the chair.—Miss M. C. **Knowles** and R. A. **Phillips**: *Leucojum aestivum*, the summer snow-flake. This well-known garden plant is a native of Asia Minor and Europe. In these countries it grows in swamps and wet, marshy meadows along river banks and on the shores of large lakes. In England the plant has a wide range on the southern rivers under exactly similar conditions. The snow-flake has recently been found in Ireland, growing spontaneously and abundantly with exclusively native vegetation, along the banks of the Shannon, the Slaney, the Nore, and the Suir, and with surroundings and associates in no way differing from those prevailing on the Continent, where the plant has always been considered native.

PARIS.

Academy of Sciences, June 13.—M. Émile Picard in the chair.—G. **Lippmann**: A brake for the balance in the form of a plumb-line. A silk fibre, stretched by a small weight, is arranged so that it can be brought lightly in contact with the beam of the balance. The oscillations are thus rapidly reduced, and the weighings rendered more rapid.—Armand **Gautier**: The action of hydrogen upon carbon monoxide; the formation of water and methane. The action of water at a red heat on the same oxide. Applications to volcanic phenomena. Hydrogen and carbon monoxide commence to react at 400° C., water and carbon dioxide being formed. The production of water passes through a maximum at about 1200° C. At higher temperatures some methane is also produced. Carbon monoxide and water at temperatures between 500° C. and 900° C. give minute traces of formaldehyde.—Paul **Sabatier** and A. **Mailhe**: The formation of the thiols and their decomposition: synthesis of the neutral alcoholic sulphides. Starting with isoamyl alcohol, the yield of sulphide in the presence of seven catalytic substances has been studied, the best result (70 per cent.) being obtained with thoria. With phenol, thoria again proved the best catalytic agent, although the yield even with this reagent was poor. For the catalytic decomposition of the thiols cadmium sulphide was used at temperatures between 300° C. and 380° C. The principal reaction was the formation of the alkyl sulphide and hydrogen sulphide, but some hydrocarbon, C_nH_{2n}, was formed by a secondary reaction.—Émile **Marchand**: New observations concerning the effects of the passage of the earth through the tail of Halley's comet. A correction in the date mentioned in an earlier communication (May 30), together with some remarks on the appearance of the solar corona.—MM. **Cirera** and **Pericas**: A *résumé* of the observations on Halley's comet made at the Observatory of Ebra, Spain. Observations of the length of the tail showed a distinct diminution after the passage of May 19. A series of photographs taken on thirteen days between May 5 and June 6 brought out the changes in aspect and dimensions of the comet.—D. **Eginitis**: Observations of Halley's comet.—J. **Baillaud** and A. **Boinot**: Changes in the nucleus of Halley's comet. A detailed account of the change of the nucleus from elliptical to circular form, and the appearance of a secondary nucleus.—Léon **Autonne**: The commutative groups of hypercomplex quantities.—A. **Buhl**: The transformation of asymptotic series into series of convergent Taylorian polynomials.—N. **Saltykow**: The applications of the theorem of S. Lie generalised.—René **de Saussure**: Opposed solid bodies.—J. **Le Roux**: Bending.—J. **Arnoult**: The movement of a wire in space.—Rodolphe **Soreau**: The thrust on the bearing surface of aëroplanes.—Paul **Mercanton**: The stability of magnetisation of lake pottery. The method of G. Folgheraiter for determining the sense and magnitude of the magnetic inclination by means of natural and artificial baked earths depends essentially on the hypothesis that the magnetisation taken by the clay in the course of its baking has not sensibly varied in the course of ages. By means of a study of the magnetic properties of the pieces from a single pot (Neuchâtel) the author comes to the conclusion that the method of Folgheraiter is justified.—M. **Barre**: Some double sulphates of thorium.—P. **Roger-Jourdain**: The oxidation of aluminium amalgam. From a study of the gases evolved from the product of the oxidation of aluminium amalgam, it is shown that there is present a mixture of aluminium carbonate and peroxide.—P. **Mahler** and E. **Charon**: The examination of the liquids produced by the action of air on coal at temperatures between 125° C. and 200° C. The liquid obtained by passing air over heated coal and cooling the issuing gas contained considerable quantities of acetic acid, together with traces of formic acid, acetone, and methyl alcohol.—P. J. **Tarbouriech**:

1-Methyl-2-ethanoyl-cyclohexane.—Marcel **Delépine**: Some new cases of spontaneous oxidation with phosphorescence. The compounds $CH_3.O.CS.Cl$, $C_2H_5O.CSCl$,

$$CH_3O.CS.CH_3, \text{ and } CSCl_2,$$

all show this phenomenon.—H. **Gault**: Remark on the acidity of the derivatives of oxalacetic acid. These acids can be titrated with phenolphthalein as indicator either in alcohol or acetone solution.—MM. **Brocq-Rousseu** and Edmond **Gain**: The excretions of roots.—Jean **Daniel**: The structure of the short old branches of some trees.—E. **Voisenet**: The formation of acrolein in the disease causing bitterness in wines. The presence of this aldehyde in bitter wines was conclusively proved.—C. **Gessard**: The fibrin ferment.—Mieczyslaw **Oxner**: Biological analysis of the phenomenon of generation in *Lineus ruber* and *Lineus lacteus*.—Lucien **Mayet** and Laurent **Maurette**: The discovery of a burial cave, probably Neolithic, at Montouliers (Hérault). Fourteen human skulls and other bones were found, probably of Neolithic age.—H. **Guilleminot**: Exposure in medical radiography, with or without a reinforcing screen.—Armand **Dehorne**: The mechanism of reduction in *Sabellaria spinulosa*.—Jules **Welsch**: The peat deposits on the coast of the west of France.—Carl **Störmer**: Photographs of the aurora borealis and a new method of measuring their altitude. More than 400 successful photographs have been taken of the aurora, and by means of simultaneous photographs at two stations 4·3 kilometres apart the height has been determined. The altitudes found were between 50 and 190 kilometres.

FORTHCOMING CONGRESSES.

JULY 10–25.—International American Scientific Congress. Buenos Aires. Address for inquiries: President of the Executive Committee, c/o Argentine Scientific Society. 269 Calle Cevallos, Buenos Aires.

JULY 27–31.—International Congress on the Administrative Sciences. Brussels. Secretary of British Committee: Mr. G. Montague Harris, Caxton House, Westminster.

AUGUST 1–6.—International Congress of Entomology. Brussels. Chairman of Local Committee for Great Britain: Dr. G. B. Longstaff, Highlands, Putney Heath, S.W.

AUGUST 1–7.—French Association for the Advancement of Science. Toulouse. President: Prof. Gariel. Address of Secretary: 28 rue Serpente, Paris.

AUGUST.—International Congress of Photography. Brussels. Correspondent for United Kingdom: Mr. Chapman Jones, 11 Eaton Rise, Ealing, W.

AUGUST 2–7.—International Congress on School Hygiene. Paris. General Secretary: Dr. Dufestel, 10 Boulevard Magenta, Paris. Hon. Secretaries for Great Britain: Royal Sanitary Institute, 90 Buckingham Palace Road, S.W.

AUGUST 15–20.—International Zoological Congress. Graz (Austria). President: Prof. Ludwig von Graff. Address for inquiries: Präsidium des VIII. Internationalen Zoologen-Kongresses, Universitätsplatz 2, Graz (Österreich).

AUGUST 18–26.—International Geological Congress. Stockholm. General Secretary: Prof. J. G. Andersson, Stockholm 3.

AUGUST 29 TO SEPTEMBER 6.—International Union for Cooperation in Solar Research. Mount Wilson Solar Observatory. British Member of Executive Committee to whom inquiries should be addressed: Prof. A. Schuster, F.R.S., Victoria Park, Manchester.

AUGUST 31 TO SEPTEMBER 7.—British Association. Sheffield. President: Prof. T. G. Bonney, F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

SEPTEMBER 8–14.—International Congress of Americanists. Mexico City. General Secretary: Sr. Lic. D. Genaro Garcia, Museo Nacional, Mexico, D.F.

SEPTEMBER 13–15.—International Congress of Radiology and Electricity. Brussels. General Secretary: Dr. J. Daniel, 1 rue de la Prévôte, Brussels. Correspondents for United Kingdom: Prof. Rutherford and Dr. W. Makower, University of Manchester, and Dr. W. Deane Butcher, Holyrood, Ealing, W.

SEPTEMBER 18–24.—German Association of Naturalists and Physicians. Königsberg. Secretaries: Prof. Lichtheim and Prof. F. Meyer, Drummstr. 25–29, Königsberg.

SEPTEMBER 27–30.—International Physiological Congress. Vienna. President: Prof. S. Exner. General Secretary for United Kingdom: Prof. E. B. Starling, University College, London, W.C.

OCTOBER 6–12.—Congrès International du Froid. Vienna. Correspondent for United Kingdom: Mr. R. M. Leonard, 3 Oxford Court, Cannon Street, E.C.

DIARY OF SOCIETIES.

THURSDAY, JUNE 23.

ROYAL SOCIETY, at 4.30.—The Damping of Sound by Frothy Liquids: A. Mallock, F.R.S.—Dispersion of Light by Potassium Vapour: Prof. P. V. Bevan.—Additional Refractive Indices of Quartz, Vitreous Silica, Calcite and Fluorite: J. W. Gifford.—The Absorption Spectra of Sulphur Vapour at Different Temperatures and Pressures, and their Relation to the Molecular Complexity of this Element: J. I. Graham.—The Wave-making Resistance of Ships: a Study of certain Series of Model Experiments: Dr. T. H. Havelock.—The Blood Volume of Mammals as Determined by Experiments on Rabbits, Guinea-pigs and Mice: and its Relationship to the Body Weight and to the Surface Area Expressed in a Formula: Dr. Georges Dreyer and William Ray.—Autotoxæmia and Infection: E. C. Hort.

FRIDAY, JUNE 24.

PHYSICAL SOCIETY, afternoon.—Visit to National Physical Laboratory.

TUESDAY, JUNE 28.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Classification of the British Stone Age and some New and little-known Horizons and Cultures: W. J. Lewis Abbott.

WEDNESDAY, JUNE 29.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, JUNE 30.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: A New Method for the Quantitative Estimation of Hydrocyanic Acid in Vegetable and Animal Tissues: Dr. A. D. Waller, F.R.S.—On the Comparative Toxicity of Theobromine and Caffeine as measured by their Direct Effect upon the Contractility of Isolated Muscle: Dr. V. H. Veley, F.R.S., and Dr. A. D. Waller, F.R.S.—(*a*) "Muhinyo," a Disease of Natives in Uganda; (*b*) The Natural Food of *Glossina palpalis*: Sir David Bruce, F.R.S., and others.—The Relation of Light Perception to Colour Perception: Dr. F. W. Edridge-Green.—The Anatomy and Morphology of the Leaves and Inflorescences of *Welwitschia mirabilis*: Miss M. G. Sykes.—The Relative Atomic Weights of Nitrogen and Sulphur: F. P. Burt and F. L. Usher.—And other papers.

CONTENTS.

THURSDAY, JUNE 30, 1910.

A TREATISE ON ANTS.

Ants: their Structure, Development, and Behaviour. By Prof. W. M. Wheeler. Pp. xxv+663. (New York: Columbia University Press; London: Macmillan and Co., Ltd., 1910.) Price 21s. net.

FROM the classic work of Huber to that of Forel our knowledge of ant life made comparatively little progress. Forel's remarkable researches, however, gave it a great impetus, and since then the students of this most fascinating department of natural history have been numerous and their discoveries most interesting.

Prof. Wheeler, who shows a most generous desire to do justice to other observers, and has himself contributed much to our knowledge, gives a bibliography which occupies no fewer than seventy pages of his work.

The most comprehensive contributions, he says,

"have been made by Forel and Emery, but important work has been done by Adlerz, Ernest André, Bates, Belt, Bethe, Brauns, von Buttel-Reepen, Ebrard, Escherich, Goeldi, Heer, J. Huber, von Ihering, Janet, Karawaiew, Lameere, Lespès, Lubbock, Mayr, Moggridge, Reichenbach, Reuter, Rothney, Santschi, and Sykes."

Yet for many years there has been no comprehensive treatise on the subject. Prof Wheeler, who promises us also a systematic monograph which will no doubt be most useful, has endeavoured, as he tells us,

"to appeal to several classes of readers—to the general reader, who is always more or less interested in ants; to the zoologist, who cannot afford to ignore their polymorphism or their symbiotic and parasitic relationships; to the entomologist, who should study the ants if only for the purpose of modifying his views on the limits of genera and species; and to the comparative psychologist, who is sure to find in them the most intricate instincts and the closest approach to intelligence among invertebrate animals."

Chapter i. the author devotes to "Ants as Dominant Insects," discussing their interest for man, the probable causes of their dominance, the comparison of human and ant societies, the analogy between the ant colony and the cellular organism, the economic importance of ants, and their great interest as objects of biological study.

He then proceeds to their external structure—the segmentation of the body; the integument; the head, thorax, and abdomen. In the third chapter he deals with their internal structure—the alimentary tract; the glandular system; the reproductive organs and poison apparatus; the circulatory system and fat body; the respiratory, and, lastly, the muscular, system.

The fourth chapter is also devoted to the internal structure, and especially that of the nervous system and sense organs. In chapter v. he takes up their development—the care of the young; the egg, larva, pupa, and perfect insect; their length of life, and resistance to noxious influences. Chapter vi. deals with polymorphism, its extent and character; the phylogenetic origin and development; Weissmann's, Spencer's, and Emery's theories; the three aspects of the problem—physiological, ethological, and psychological; and the explanation of the development of the worker.

The same subject is continued in chapter vi., and especially the origin of the worker; the relation of instinct to polymorphism; the differentiation in function as the precursor of differentiation in structure.

Chapter viii. deals with the history of myrmecology and the classification of ants; ix. with their distribution; x. with fossil ants; xi. with habits; xii. and xiii. describe the various forms and structure of nests, their characteristics, the method of construction, &c.; xiv. deals with the Ponerine ants, which the author regards as unmistakably primitive, and the ancestors of the higher and more developed groups; xv. is devoted to the driver and legionary ants; xvi. to the harvesting ants; xvii. to the relations between ants and vascular plants; xviii. to the fungus-growing ants; xix. to the relations of ants to aphides, scale insects, tree hoppers, and caterpillars; xx. to honey ants; xxi. and xxii. to ant guests and parasites, especially beetles, flies, hymenoptera, diptera, mites, and nematodes.

Interesting as these chapters are, the next are even more so. They deal with the extraordinary relations existing between ants of different species; compound nests and mixed colonies; ant parasites; slave-making ants; degeneration as the result of dependence on others—a lesson, as he justly points out, to our statesmen and electors.

In chapter xxviii. the author comes to the sensations of ants, different types of behaviour, the senses as a basis for study, touch, smell and taste, hearing and vision.

The ocelli, which occur in the earliest known fossil insects, are supposed to give an indistinct visual image of very near objects, but, as he says, this view is not yet clearly established.

In chapters xxix. and xxx., Prof. Wheeler discusses the question of instinct, and concludes with five appendices, on (*a*) methods of collecting, mounting, and studying ants; (*b*) key to the subfamilies, genera, and subgenera of the North American Formicidæ, for the identification of the workers; (*c*) a list of described North American ants; (*d*) methods of exterminating noxious ants; (*e*) literature.

Any one of these chapters would afford ample materials for review, but this would involve too great a claim on the space at my disposal.

I will only say a few words on the concluding chapters, in which Prof. Wheeler deals with the instincts of ants (chapter xxix.) and their plastic behaviour (chapter xxx.).

He accepts the old scholastic distinction between "memory" and "recollection," one being used

"in the sense of having ideas of absent objects, rather than in the sense of behaving differently to present objects because of past experience with them. The dog shows clearly that he remembers his master in the latter sense by displaying joy at the sight of him. Can we be sure that he has remembered him in the

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former sense during his absence; that is, that he has had a memory image of him?"

For my part, I cannot doubt this.

Prof. Wheeler attempts to explain away the evidence on which good naturalists—Leuckart, Romanes, and others—have relied, and in several cases it seems to me that he does so satisfactorily. I do not myself regard the supposed case of ants dropping intentionally from ceilings on to food as definitely proved, but when Prof. Wheeler explains, or attempts to explain, it away by suggesting that "it may be a much more frequent method among ants of clearing vertical distances than has been supposed," one cannot but ask how it originated, and how it became so frequent.

The evidence, indeed, is contradictory, and difficult to reconcile. This applies not merely to the facts recorded by different observers. I have myself met with cases apparently showing intelligence, and others which seemed to imply the very reverse. Might not, however, the same be said in the case of man himself?

In conclusion, I may say that the illustrations are numerous—nearly 300—well chosen, and most of them good. Prof. Wheeler is much to be congratulated on having produced an excellent work, for which naturalists will, I am sure, be grateful.

Avebury.

PRACTICAL METHODS FOR THE BIOCHEMICAL LABORATORY.

Handbuch der biochemischen Arbeitsmethoden. By Prof. Emil Abderhalden. I., Erster Band, allgemeiner Teil, erste Hälfte. Pp. iv+512. Price 18 marks. II., Zweiter Band, spezieller Teil, erste Hälfte. Pp. iv+496. Price 18 marks. (Berlin and Vienna: Urban and Schwarzenburg, 1909.)

THESE two volumes form the first consignment of a comprehensive handbook of practical methods for the biochemical laboratory, which is being written by no fewer than sixty-four contributors under the guidance of Prof. Emil Abderhalden.

The second halves of each of the present volumes are promised shortly, and the third volume within the year. When it is remembered that the editor is also engaged upon research work in the laboratory, as well as his many contributors, and is, moreover, editing an equally colossal work now appearing, one can but wonder at the rapidity of German cooking of literature of this sort.

It is a pity that the articles are not published separately, as monographs for those specially interested in the individual subjects, for this would save purchasers buying a great deal of matter which they, in most cases, do not want in order to possess a much smaller part of value to them.

As it stands the work has no general interest, and while it may be serviceable in parts as a reference laboratory book, it will scarcely prove attractive or profitable for the private purchaser.

One wonders, in looking over the table of contents of the present and contemplated volumes, why the pretence is made that it is issued in three volumes, since by the simple device of making two halves of each of these divisions it comes to be in six volumes. It might equally well have been issued in one volume of six parts, each part forming a good sized volume; or in two volumes each of three parts; or in six volumes each of one part; or there might have been another and even better alternative.

The work can only be intended for the assistance of the research worker in a biochemical laboratory, and, looking at the matter from his point of view, it is surprising that the editor has allowed the first of the present volumes to appear in his work. All that is novel or interesting to the researcher in biochemistry of the five hundred pages it contains might readily, and with great gain in interest and utility, be compressed into fifty pages. As it stands it looks like nothing more than a glorified collection of catalogues of dealers in laboratory supplies; with the names of the dealers and prices of the commodities left out, much to its disadvantage. Scores of pages are sacrificed to drawings, photographs, and descriptions of apparatus with which we all have been familiar from our youth onwards in our everyday laboratory work. The first article in the volume dealing with this kind of thing occupies 282 pages; the new matter in it could easily be put into thirty pages. If the prices and makers' names were given, it might be of some service in the laboratory; as it is, to order any of the newer apparatus which suited any particular purpose, one would have to refer from the present work to the original paper by the inventor of the apparatus, where possibly the information might be obtained.

In striking contrast with this article of 282 pages is the one succeeding it, of less than seven pages, on the ultra-microscope, written by Fr. N. Schulz, of Jena. Knowing the valuable work of this author in the particular field in question, one expected something good here; but there is nothing new. It might almost be a reprint, as are the illustrations in it, of one of the advertisements of Carl Zeiss advertising the instruments.

There follow on this all too short article a number of lengthy ones on ultimate organic analysis, ash determinations, &c. Nearly all this matter has been written many times before, is contained in all practical works on organic chemistry, and is familiar to any but the merest tyro in biochemical work. For example, illustrations with descriptions of the combustion furnace and the combustion tube and its filling are given; eighteen pages are used up in descriptions of the Kjeldahl method for determining nitrogen, and illustrations are given of most of the modifications which perverted human ingenuity and waste of genius have given rise to for carrying out that somewhat simple method of analysis. Fourteen pages in a special article go to a description of specific-gravity methods—why not instead refer the reader to an elementary work on physics?

The second of the two volumes before us will be of more service to the biological chemist whose path is touched by the articles contained therein; these articles deal with the preparation, separation, and qualitative and quantitative estimation of the important lower and

higher alcohols, the carbohydrates, the fats and waxes, the phosphatides, the vegetable proteins, and the animal proteins. The volume concludes in the middle of an article by the editor on the disintegration products of the proteins, characterised by much work of a patient and laborious type. The reader is deserted in the middle of a sentence, with "möglichst" for his last word, but it may be confessed that one can wait for the next issue of the fascinating narrative with more patience than one was able to command in earlier days of reading serial literature.

The articles in this part are of unequal value and exhaustiveness; that on the phosphatides is much too short; very valuable are the three articles, on sugars by B. Tollens, that on glycogen by K. Grube, and especially that on the proteins of the vegetable world by T. B. Osborne, which is a model of what an article on practical methods for the laboratory ought to be.

Such articles as these make the work essential in a biochemical laboratory, but it is a pity that they cannot be purchased as monographs in the particular subjects. BENJAMIN MOORE.

THE LIGHT FROM THE SKY.

Meteorologische Optik. By Prof. J. M. Pernter. Section IV. Pp. i–xvii, 559–799. By Felix M. Exner. (Vienna and Leipzig: W. Braumüller, 1910.)

THIS volume is the fourth part of the late Prof. Pernter's work on meteorological optics, a notice of the earlier parts of which appeared in NATURE on April 18, 1907. It was undertaken in March, 1908, by Dr. Exner at Pernter's request, at a time when the latter's condition of health not only made it impossible that he should complete the work himself, but prevented him from giving any material assistance or advice in its preparation. The scope of the section was clearly indicated in the original plan of the work, and as regards the method of presentation Exner has successfully followed that of the preceding sections; but he had no notes to assist him, and the volume must therefore be regarded as Exner's work, except in so far as he has utilised, in some portions, Pernter's previously published papers.

In pursuance of the general scheme outlined in the previous notice above referred to, this fourth section is devoted to the discussion of those phenomena which are due to the action of the minute particles of all kinds which are always present in the atmosphere, among which must be included the gaseous molecules themselves. Thus the first two chapters deal with the colour and polarisation of sky-light, the third treats of the loss of light in passing through the atmosphere and the general brightness of daylight, while in the fourth chapter is given a brief account of what are called the phenomena of twilight, the optical effects associated with sunrise and sunset.

Of all the many interesting problems the discussion of which falls under the head of meteorological optics, that of the colour of the sky, with the associated questions as to the polarisation of sky-light, its intensity and composition, and the effects of atmospheric absorption, is perhaps the most fascinating. Less striking only because not exceptional, in the sense in which this adjective applies to the appearances dealt with in the earlier sections, even for the unscientific observer the everyday recurrence of the phenomena fails to diminish their appeal to his artistic sense and imagination. For the physicist, the satisfactory explanation of all the main features, apart from the quantitative uncertainty in the details which is an almost inevitable consequence of the complexity of the conditions, must be ranked among the triumphs of science, and constitutes one of the most beautiful applications of the wave theory of light.

The view has long correctly been held that the colour of the sky is due to the presence in the atmosphere of suspended particles, and the explanation was rendered more certain by the experiments of Brücke in 1853 and of Tyndall in 1868 on the colour and polarisation of the diffused light from artificially "clouded" media. The first exact account as to the manner in which the particles produced the effects observed was, however, given by Lord Rayleigh in 1871, in his paper on the light from the sky, its polarisation and colour. It was there shown that the presence in the atmosphere of particles of dimensions small compared with the wave-length of light would give rise to secondary radiations of intensity inversely proportional to the fourth power of the wave-length, and completely polarised in the plane at right angles to the direction of the primary radiation from the sun. In this secondary, diffused radiation, the short waves would therefore greatly preponderate, and the colour seen would be blue or violet, while the long waves would be the more readily transmitted, and the primary radiation seen through such an atmosphere would tend to be orange or red. At the same time, Rayleigh disposed of Clausius's theory that the phenomena were due to the presence in the atmosphere of small—but not small relatively to the wave-length—hollow spherical vesicles reflecting and refracting according to the ordinary laws for extended media. In a much later paper Rayleigh has given good reason for inferring that at least one-third of the scattered light is diffracted from the molecules of the air themselves (see also NATURE, March 10, 1910, p. 49).

One of the merits of Exner's discussion of the subject is the care with which he has followed out the application of Rayleigh's theory in the light of the best recorded observations. These relate to colour, polarisation, extinction coefficients, the general brightness and the distribution of brightness of the sky, &c.; indeed, the whole volume may almost be regarded as an excursus on the Rayleigh theory. In dealing with the more detailed phenomena of Arago's "positive" and "negative" polarisation, and the neutral points of Arago, Babinet, and Brewster, the author follows Soret in attempting a general explanation in which account is taken of the further action of other particles on the light already once diffracted, and of the form of the limited portion of the atmosphere from which the light reaching any individual eye can be received; but the conditions are too complicated to admit of quantitative treatment for exact comparison with observation.

The optical appearances connected with sunrise and sunset are somewhat briefly treated, reference being especially made to Kiessling's monograph "Untersuchungen über Dämmerungserscheinungen" for a more complete description of the phenomena. Some account of the observed effects due to the Krakatoa eruption and other similar disturbances is included.

Dr. Exner has followed Prof. Pernter in the careful reproduction of the best recorded and historically interesting observations of the phenomena. He has himself emphasised the impossibility of reproducing the charm of Pernter's work, dependent as it was on the latter's extensive knowledge of the literature of the subject as well as on his critical judgment. This volume will, however, be welcomed both as a fitting completion of the task undertaken by Prof. Pernter and as a valuable survey of the progress which has been made in the interpretation of the phenomena with which it deals.

THE PHILOSOPHY OF MATHEMATICS.

Methodologisches und Philosophisches zur Elementar-Mathematik. By Dr. G. Mannoury. Pp. viii+279. (Haarlem: P. Visser Azn., 1909.) Price 8*s.* 10*d.*

THIS work is the outcome of lectures delivered by the author at the University of Amsterdam, and retains in different ways the marks of its origin. Its frequent digressions, its general discursiveness, and its rather sketchy character make it difficult to describe; and many of the topics are so controversial that where one reader will agree with the author, another, equally competent, will entirely dissent. Still, it is an honest and interesting attempt to deal, from the philosophical side, with the fundamental difficulties of mathematics, and as such deserves attention.

The first part contains five chapters dealing respectively with unity and plurality, finite and infinite numbers, the elementary laws of arithmetic applied to whole numbers, the extension of the idea of number, and, finally, the definition of irrationals. The second part is devoted to geometry, and its four chapters discuss respectively mathematical logic; elementary constructions, postulates, and theory of measurement; non-Euclidean geometries; and the notion of space from the standpoint of physiology and psychology.

A few examples must suffice to illustrate the merits and the defects of the author's procedure. Take the question of defining a unit. After pointing out, rightly enough, that there is no such thing as an objective unit directly perceived, he gives as a formal definition (p. 31):—"Units are sensation-complexes (Empfindungs-Komplexe), and a plurality (Vielheit) consists of mutually related units." Now, if there is one thing that recent mathematics has done, it is surely to clarify and make precise the notion of a unit apart from all elements of sensation. Verbal definition of a unit is a small matter, of course; the thing to be desired is the complete notion. As a matter of fact, everybody does acquire the notion more or less exactly, long before thinking about defining it; and as to the definition, a kindergarten teacher will succeed where a philosopher will fail. "These are toys; each toy is a unit among the toys"; "You are my class; each of you is a unit of the class"; such examples will convey the meaning of the term "unit" better than any formal definition. At the same time, if we must have a metaphysical example of a unit, the ego seems to be the best, for it cannot be denied, or affirmed to be a plurality, without an intrinsic contradiction in terms. If Jones makes a statement or forms an opinion, however erroneous, it is *his,* and this "he" is an irreducible entity which has a preeminent claim to be called a unit. It may be remarked that Dr. Mannoury expressly objects to this line of argument, apparently on the ground that the idea of the ego is a derivative one; this may be admitted in a sense, as a fact in the development of an individual consciousness, but it does not make the ego derivative, any more than the deciphering of hieroglyphics in recent times affects the date at which they were carved. Is not this one of those cases where psychology is appealed to where it is really irrelevant, the question being one concerning metaphysical data? We must have something *a priori* and undefined in any science; the question is, how few and how fundamental (or elementary) may we assume these data to be?

A more striking example of the same sort of thing is to be found on p. 263, where the author speaks of "the four-dimensional space-time-notion which is to be regarded as an image of the whole group of sensations." It is almost impossible to give any sense to this phraseology, consistent with either popular or mathematical usage. If it merely means that in abstract kinematics in three-dimensional space there are four independent variables (x, y, z, t), it is a very unsatisfactory way of stating a simple fact; and it is very doubtful whether kinematics is, properly, an image of sensations, any more than our sensation of the colour of homogeneous light is imaged by its wave-length.

In treating of the elementary laws of arithmetic, the author, in the text, mainly follows those who appeal to the principle of analogy or "permanence"; he does not give a detailed discussion of the elementary operations. The definition of irrationals is Dedekind's, which is wrongly attributed to Dirichlet; there is a brief account of Peano's system of shorthand, and a section on mathematical induction, with quotations from Poincaré, Couturat, and others. Dr. Mannoury is evidently dissatisfied with Poincaré's arguments, but here, as in other cases, he does not bring forward any very definite statements of his own.

In the geometrical section there are several features of interest, and this is the most readable part of the book. A fair account is given of the different types of three-dimensional geometry, of Hilbert's non-Desarguian system, and of metrical geometry based on a movable standard assumed to be rigid. But there is no discussion of a system of definitions, and the only element treated in any detail is the straight line. With regard to the different types of geometry, the author adopts the sensible attitude that it is now, and always will be, impossible to fix on one as the

"actual" geometry of space, and he would probably assent to Poincaré's dictum that the science of mathematics is neither true nor false.

There is one remarkable statement made which deserves mention. Dr. Mannoury says that in December, 1818, F. K. Schweikart sent to Gauss a note asserting the existence of a geometry in which the sum of the angles of a triangle is less than two right angles, and in which the altitude of an isosceles triangle with a finite base has a finite upper limit. This goes far to demolish the claim made for Gauss that he was the first to assert the possibility of a consistent system of geometry distinct from that of Euclid.

G. B. M.

THE PROTOZOA: AN IMPRESSIONIST SKETCH.

Protozoölogy. By Prof. Gary N. Galkins. Pp. 349. (New York and Philadelphia: Lea and Febiger; (London: Baillière, Tindall and Cox, 1909.) Price 15*s.* net.

TO attempt to condense our present knowledge of the Protozoa into some three hundred pages is—to anyone acquainted with the subject—to attempt the impossible. This book, however,

"does not aim at being an exhaustive treatise on the Protozoa; it aims, rather, to give an introduction to the study of modern protozoology as seen from the author's point of view."

It would therefore be unfair to draw comparisons with Doflein's recent masterpiece on the subject which appeared almost simultaneously.

As we differ fundamentally from the author in many matters of interpretation—both as regards general principles and detailed facts—we can here consider only a few points which a perusal of the work has suggested.

With regard to the tentative classification of the Protozoa which is adopted, we can only say that it is, perhaps, as good as any which has so far been advocated. With our present knowledge, it is not possible, we believe, to arrive at a satisfactory classification of the whole group. At present there must be many tadpoles among our fish. It may be noted, however, that the author does not accept Hartmann's group "Binucleata"—for trypanosomes and their allies and Hæmosporidia—and in this we heartily agree with him. It may be noted, further, that the Spirochæts are classified (with some reservation) among the Mastigophora; the Mycetozoa are ranked under the Rhizopoda; the Opalinidæ are placed among the holotrichous Ciliata; and the Mastigamœbæ are placed, in the order Monadida, with the Mastigophora. Though these groupings are usual, they are none the less, we believe, unjustifiable in the light of recent work.

In dealing with the trypanosomes, the author adheres to Schaudinn's much-debated work, because he finds

"the schematic figures and categorical descriptions of Schaudinn's original contribution are still the most convincing of all such attempts to describe the nuclear changes."

The life-cycle of Paramecium is described as a "typical" one. With this we cannot agree, because we consider the Ciliophora to be very different from all other organisms. Moreover, we regret to find no allusion to the recent important work of Enriques and others in this connection.

A remarkable account of autogamy in *Amoeba limax* is given, apparently from the author's own (unpublished?) observations, though no indication of this is given. Autogamy is again alleged to take place in *Amoeba proteus,* though this has not been by any means proved. It is disappointing to find no reference, in this connection, to Prandtl's important work on Cryptodifflugia ("Allogromia").

It seems to us that undue prominence has been given to many very questionable organisms, such as "*Cytorrhyctes variolae,*" the "Negri bodies," &c. (described, by the way, under "Parasitic Rhizopoda"), whilst many important life-histories, *e.g.* Opalina, Mastigella, Trichosphærium, Stylorhynchus, &c., receive little more than passing mention.

The remarkable form Aggregata is mentioned only in the classification, where it is placed among the cephaline gregarines! One can only suppose that this is an oversight; and we regret to see that the very doubtful work of Dallinger and Drysdale has found its way into yet another text-book.

Throughout the book, generic names are often written in ordinary type, without a capital letter, although in many cases the customary convention is adopted—frequently in the same paragraph. We think this is to be deplored, more especially so because medical men—to whom, on account of the large amount of space devoted to parasitic forms, the book will specially appeal—are at present particularly prone to write zoological names incorrectly. In addition, the author's apparent dislike of diphthongs causes him to adopt the spellings not only Paramecium (correctly), but also Ameba, Actinospherium, Spirocheta, &c., and even Jenia (for Joenia).

These criticisms are, however, of minor points. The chief value of the book lies in the fact that it gives us a unified picture of the many problems of protozoology as they present themselves to a worker who has devoted many years of original research to his subject. Without doubt, the book will be welcomed by many, because there exists no other modern work in English which attempts to deal with the present state of protozoology within the compass of a single volume.

C. CLIFFORD DOBELL.

BEE-KEEPING IN AMERICA.

How to Keep Bees for Profit. By Dr. D. E. Lyon. Pp. xii+329. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 6*s.* 6*d.* net.

THIS is a book on bee-keeping in the United States. The author is a well-known bee-keeper, and an entertaining writer; he has a happy way of briefly explaining the chief operations of the apiary in a personal style that does not weary the reader. Dr. Lyon tells us that many years ago he acquired the "bee fever," "from which he has never recovered,

and never expects to recover." The chief symptoms of this affection, enthusiasm and optimism, pervade his book, but he is careful not to exaggerate the profits of bee-keeping; the methods and appliances he describes are all well known and well tried, though some of them are unsuited to bee-keeping in England.

The clipping of queens' wings to prevent swarms absconding is recommended, but this practice is seldom employed in England, chiefly because the queen is likely to perish in the grass unless the bee-keeper happens to be present at the moment of swarming to find her and put her back into the hive.

The author, in saying (p. 52) that "it has not been definitely determined whether in laying an infertile egg from which springs the drone, the queen lays it through choice, or is compelled to owing to the increased size of the drone cell," seems to be unacquainted with the fact that a queen will sometimes lay large numbers of fertile eggs in drone cells.

Among the enemies of the honey-bee that the American apiarist has to contend with are skunks, "who seem to have a fondness for bees, and the little rascals will, in the shadow of night, scratch on the alighting board of a hive to lure the sentinels out for investigation, only to be gobbled up by their odoriferous enemies." "In warm climates the dragonflies kill a large number of virgin queens when in flight, and in certain sections they are so numerous that commercial queen-rearing is well-nigh an impossibility."

Dr. Lyon finds he is less liable to be stung in a white cotton suit than when he wears dark woollen clothes, and wonders whether it is because the bees detect the animal scent in the woollen goods or have a natural aversion to black.

On pp. 12 and 13 we are unfortunately informed that the eggs of workers, drones, and queens hatch respectively in twenty-one, twenty-four, and sixteen days, instead of that these are the periods taken by these bees to develop from the time the egg is laid; but this will no doubt be put right in a second edition, which is likely to be wanted before long by the great nation across the ocean, in whose favoured country the bee-keeping industry has grown to great importance.

Very attractive features of the book are its handy size, clear, large type, and beautiful photographs. Bee-keepers, both prospective and actual, will appreciate this evident effort of printers and publishers to give them their best.

F. W. L. SLADEN.

OUR BOOK SHELF.

Ektropismus oder die physikalische Theorie des Lebens. By Felix Auerbach. Pp. v+99. (Leipzig: W. Engelmann, 1910.) Price 2.60 marks.

EACH fresh theory of life which is put forward by thinkers will doubtless find a certain number of adherents, even if, as in the present instance, it is unsupported by anything in the nature of experimental evidence. This sort of evidence is just the kind which it is so difficult to obtain, and new theories lead one but very little nearer to the solution of the great problem. Auerbach's brochure contains nothing really new, and he clothes his ideas in a considerable amount of verbiage. No one can doubt that life with its characters of growth and development is a form of energy, but the psychical aspects of life have always been a stumbling-block in the full acceptance of a purely physical theory. Ectropism, the term selected by the author, is not entirely a physical theory; he tells us that ectropism is neither materialism nor idealism, neither formalism nor phenomenalism; it is certainly not monism, but, in a certain sense, it is dualistic. From this one learns what ectropism is not, and one could wish that the rest of the book, which tells us what it is, was equally explicit. We must, however, leave those of our readers who are interested in speculations of this nature to unravel it for themselves.

A Text-book of Physical Chemistry, Theory and Practice. By Dr. Arthur W. Ewell. Pp. ix+370. (Philadelphia: P. Blakiston, Son and Co., 1909.) Price 2.25 dollars net.

TEXT-BOOKS of physical chemistry are generally written by chemists, which is natural enough, since the subject is much more widely studied by chemists than by physicists. It is therefore a pleasant change to come across a text-book of physical chemistry written by a physicist. As one might expect, the treatment is less descriptive and more mathematical, with greater precision in the definition of physical magnitudes and greater strictness in the deductions. The work under review is an excellent example of this type, being brief, pointed, and consistent. It is not exactly a book which the young chemist without previous knowledge of the subject would be likely to read with profit, but it can be warmly recommended to those who, either by hearing a course of lectures, or by the perusal of one of the more chemical text-books, have attained some acquaintance with the subject-matter and desire to systematise their knowledge.

The value of the book is greatly enhanced by the inclusion of questions and mathematical exercises on the subjects discussed. The directions for practical work err occasionally on the side of conciseness, but should in any case prove useful to the student who cannot always have a demonstrator by his side.

Vorträge und Aufsätze über Entwickelungsmechanik der Organismen. Edited by Prof. W. Roux. Heft x., Über die gestaltliche Anpassung der Blutgefässe. By Prof. Dr. Albert Oppel. Pp. ix+182. (Leipzig: W. Engelmann, 1910.) Price 4.40 marks.

THIS is a useful and interesting contribution to the study of development, dealing, as its name indicates, with the blood-vessels, and the way in which they are adapted to the needs of the organs or tissues they supply and to the changes which these undergo. This adaptation is divided into three periods, the first during which inherited characters determine the course of development; the third is the period of full functional life during which the changes are the result of functional stimuli; the second or intervening period is that in which both factors come into play. The changes dealt with in detail are not merely those dependent on quantity of the blood supply; but the various coats of the blood-vessels, especially the muscular coat, with its nerves, undergo alterations in consonance with the needs of the tissues. An important section deals with the collateral circulation, and another, by no means the least interesting, with the recent remarkable results which have attended attempts to transplant organs from one animal to another. The value of the book is increased by a copious bibliography.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

The Descent of a Sphere in a Viscous Liquid.

STOKES'S formula for the terminal velocity of a sphere descending in a viscous liquid under the action of gravity has been recently tested by Prof. John Zeleny and Mr. A. A. Keehan ("British Association Report," 1909, p. 407), and they found that the values of the velocity furnished by it were considerably larger than those which they obtained from their experiments. Since Stokes's formula is obtained on the hypothesis of no slipping, it furnishes an *inferior* limit to the velocity, and consequently the discrepancy between theory and observation cannot be explained on any hypothesis that slipping takes place.

I think that a possible explanation is the following. The equation determining the current function contains the term $d\psi/dt$, the origin being some *fixed* point in the line of motion of the sphere; and if the motion be referred to the centre of the sphere as a moving origin, $d\psi/dt$ must not be put equal to zero when the motion is steady, but must be replaced by $Vd\psi/dz$, where V is the constant velocity of the sphere. The retention of this term creates no difficulty so far as the integration of the differential equation for ψ is concerned, but the solution is quite different from that given by Stokes.

A. B. BASSET.

Fledborough Hall, Holyport, Berks, June 20.

Popular Biological Misconceptions.

THE object of science is to increase the knowledge of mankind in general, and not merely that of the workers in science. The methods of science may be only understood by the workers in each particular branch, but the conclusions are for all, and should be made accessible to all. The methods by which Newton established the law of gravitation can only be understood by good mathematicians, but the results can be put into words that can be understood by any educated man. I think most will agree that students of science should, so far as possible, make known their discoveries in such a way as to be understood by the layman.

In making these remarks I have biology in mind. Nothing is known of biology outside the ranks of biologists. Even Darwin's theory of evolution is most imperfectly understood by the ordinarily educated man. Probably working biologists have no idea how much it is misunderstood. When the late Lord Salisbury at Oxford said that there was nothing except pure chance to ensure the transmission of an advantageous variation, he left out of consideration the survival of the fittest, an integral part of the theory. Sir Oliver Lodge, in "Man and the Universe" (p. 38), speaking of the persistence of favourable variations, says, "given their appearance, their development by struggle, inheritance, and survival can be explained; but that they arose spontaneously, by random change, without a purpose, is an assertion that cannot be justified." This passage shows that the writer has not fully grasped the elements of the theory; the changes take place in every direction, but all variations except those in favourable directions are wiped out in the struggle for existence; such, at any rate, is the theory. When we consider that Darwin's theories are not fully grasped by scholars, it is hardly to be wondered at that the ordinarily educated man has but the vaguest ideas of biology, ideas made still more vague by the ordinarily educated writers in the daily, weekly, and monthly Press. To the ordinary man the word Darwinism means the theory that his ancestors were monkeys; he will have heard the words "survival of the fittest" used as a catch phrase, but he will have no idea of their meaning; "struggle for existence" will have no biological sense for him; "selection" he will think has something to do with sex. Biologists may say either that I am exaggerating or that the educated men of my acquaintance must be singularly few: but I can assure them that such misconceptions are shared by very many men who have been educated at our public schools and universities, which is generally (though perhaps erroneously) considered the criterion of a good education. It is quite common to come across persons who say that Darwinism is discredited by new discoveries, especially by Mendelism; they have no other idea of the meaning of Mendelism, and, seeing that their notion of Darwinism is no more than I have stated above, they arrive at conclusions that would rather astonish the average biologist.

I think it is the duty of biologists to educate the uneducated in biological matters, to tell them how matters really stand, and to tell them how far old theories are, or are not, modified by new views; but we should be educated by first-class masters, and not by second-hand popular writers. This has been done for a long time for astronomy, and, to a certain extent, for physics; it is very desirable that it should be done also for biology.

C. C.

Anomalous Reading of Hygrometer.

ON June 11 I observed a case of the wet-bulb thermometer reading higher than the dry bulb, which cannot be attributed to a falling temperature, as this anomalous condition continued for more than two hours, during the greater part of which the temperature was slowly rising. A gradually dispersing fog prevailed at the time, and the dry bulb was at first covered with precipitated moisture, but after being wiped dry it continued to read lower than the wet bulb, without any further visible deposition of moisture. This, however, may only imply that evaporation was proceeding too rapidly to allow of the fog particles aggregating into visible drops. This evaporation might account for the temperature of the dry bulb being as low as that of the wet bulb, but not lower. As thermal equilibrium will be attained by each thermometer when its rate of heat-loss is equal to its rate of heat-gain, and as the only loss of heat is by evaporation, which at most can only lower the dry-bulb reading to that of the wet, it is necessary to suppose that the wet bulb absorbs heat more rapidly than the dry. This may be accounted for by the greater thermal diffusivity of the wet bulb with its saturated muslin covering.

Experiments made by Prof. A. W. Porter at University College, London, show clearly that, in the case of steam pipes of small diameter, the effect of a lagging of badly conducting material is to *promote* the transference of heat from the interior to the exterior, and it is evident that if the external temperature be higher than the internal, the effect will be reversed, and, further, that it will be increased if the covering is not a bad conductor. We have such a covering on the wet-bulb thermometer, and as owing to evaporation the temperature of the thermometers will be lower than that of their surroundings, the direction of heat transfer will be inwards, and its rate more rapid in the "lagged" wet bulb than in the bare dry bulb. We should accordingly expect the former to come to a state of thermal equilibrium at a higher temperature than the latter.

J. ROWLAND.

St. Beuno's College, St. Asaph, June 20.

Pwdre Ser.

DOUBTLESS many of your readers will suggest that Pwdre Ser may, in some cases at least, be the jelly-like plasmodium of *Spumaria alba*, D.C., a common British myxomycete. The size, colour, time, and places where found agree well with Prof. McKenny Hughes's description, but how it should be connected with meteors this identification, if correct, would in no way explain.

AGNES FRY.

Failand House, Failand, near Bristol.

THE article on "Pwdre Ser" in your issue of June 23 has brought to my remembrance a tale of a shooting star which fell upon a connection of mine many years ago. The man was working in the field, when a mass of jelly fell upon him. I discredited the story at the time; but this article seems to lend weight to the story. I believe the man was unhurt. The occurrence happened in Wales.

ROWLAND A. EARP.

Preston Brook, near Warrington, June 27.

THE FRESH-WATER LOCHS OF SCOTLAND.[1]

A PATHETIC interest is associated with this great work. A bathymetrical survey of the Scotch fresh-water lochs, which had been already attempted in a few instances, was in vain pressed upon the Government in 1883 by the Royal Societies of London and Edinburgh, and was undertaken in 1897 by Sir J. Murray and Mr. F. P. Pullar, a young Scotchman who added to a deep interest in meteorological and hydrographical problems much practical skill as an engineer. Considerable progress had been made when, on February 15, 1901, Mr. Pullar was drowned in Airthing Loch, near his own home. The ice had broken, immersing a number of people; he rescued three, and perished in an heroic, though vain, attempt to save a fourth. As a memorial, the bereaved father, Mr. L. Pullar, devoted a sum of 10,000*l.* to the completion of the task, so that the book will be an enduring memorial to one who died to save others.

A staff was organised, and the work resumed in the spring of 1902. By the end of 1906 all the Scottish lochs of any importance, 562 in number, had been surveyed, and altogether more than 60,000 soundings had been taken. Biological and physical work was continued during the next three years; but from time to time the maps, with some of the results, enriched the pages of the *Geographical Journal,* and these, together with much new material, are now collected into the present work. The first two volumes contain the text, with various illustrations, from which we are able to reproduce two of the smaller size; the remaining four volumes the tinted maps, which—though it adds considerably to bulk and cost—are wisely mounted on linen.

FIG. 1.—Loch Maree, the Islands in the Middle Distance. From "Bathymetrical Survey of the Scottish Fresh-water Lochs."

The first volume deals with general scientific questions. Prof. Chrystal discusses seiches; for these abnormal oscillations in the water-level—first noted in the Lake of Geneva, and first seriously studied there by Prof. Forel—can be observed on the Scottish lochs, though on a much smaller scale. They are mainly due, as Prof. Chrystal shows, to variations in barometric pressure, though winds or heavy local rains or floods may be among the causes. Mr. E. M. Wedderburn writes on temperatures. In that respect th bottom water of a deep loch such as Loch Ness varie little throughout the year, and is sometimes hardl less than 2° F. below the mean temperature of th year, but conduction produces considerable intermix ture in the upper layers of water. This indirectl affects the distribution of plant and animal life, an presents some interesting problems, which must b left without further notice. Mr. G. West gives th results of studies of the phanerogams and highe cryptogams in seven Scotch lake areas. This flora like that of the mountains, has been much affected directly or indirectly, by the Glacial epoch, but th vertical range of the plants, strictly aquatic in habit depends on a number of factors—such as the amoun of humic or other acids in the waters, the surroundin rocks, and the altitude. A full discussion of these an summaries of the results form a contribution whic will be of permanent value to the botanist. Dr. Caspar gives a useful summary of information about th chemical composition of lake waters, and has als examined about seven hundred samples of botton deposits from these lochs, of which, however, th mineralogical aspect is fairly uni form, as might be expected fron the generally similar geologica conditions. Mr. John Hewitt write on the distinctive characters of th fresh-water plankton, Dr. W. A Cunnington on the nature an origin of fresh-water organism Dr. C. Wesenberg-Lund on variou limnological problems, and Mr James Murray on the biology of th Scottish lochs. According to th last-named, the following peculiar ties are noteworthy:—a richness i species of Desmids (only approache by the lakes of Ireland), a conspicu ous Arctic element in the Crustace the local distribution of many of th one and some of the other, an lastly, the absence or rarity of cer tain species common to the gener European plankton.

As a prelude to the secon volume, which is occupied by a d tailed description of the several lak basins, grouped according to the drainage, Drs. B. N. Peach an J. Horne contribute to the first one an artic on the relation of the lochs to the gener geology of Scotland, ending with a sketch of i mountain regions and valley systems, and of its hi tory during the Glacial epoch. In their opinion, th ice attained its maximum during the earlier part this, when it buried the whole region in a vast shee which, as they tell us, was met on the bed of th North Sea by another one from Scandinavia, an thus diverted northwards and southwards. In the lat part of this epoch, probably after a warmer inte lude, valley glaciers, which occasionally became co fluent, radiated from the several mountain groups, an to their action, according to the authors, the lak basins are mainly to be attributed. In regard to th subject, though it may be thought presumptuous, w venture to remark that both the map illustrating th maximum extent of the ice and some statements abo the erosive action of the latter involve difficulties which it would have been better to warn the ordina reader.

The maps and sections, which occupy the remai ing four volumes of the work, will, however, supp

[1] Bathymetrical Survey of the Scottish Fresh-water Lochs, conducted under the Direction of Sir John Murray, K.C.B., F.R.S., and Laurence Pullar, during the Years 1897 to 1908. Report on the Scientific Results. 2 vols. of text with illustrations, and 4 mainly of maps. (Edinburgh: *Challenger* Office, 1910.) Price 5*l.* 5*s.* the set.

im with materials from which he may form his own onclusions. In two of the four, the intervals between he contour lines are differently tinted, both above nd below water; in the other two, this is done only or the latter. Sections show the relation of depth o length, not only on an exaggerated scale, but also which is of great value) on a true one. Most of the cotch lakes occupy actual rock basins, but this fact f itself is not conclusive evidence of their origin. lany tarns in mountain districts are probably due to he erosive action of ice, but no one would attribute he Dead Sea to the "rooting" of a Lebanon glacier, r the Central African lakes to ice-sheets from the lountains of the Moon. Earth movements are among he possible causes of rock basins, and to which gency should the Scotch lochs be attributed? Increased erosion, due either to a confluence of glaciers r to a sudden diminution of slope in the valley floor, nay account for the smaller, but difficulties present hemselves in applying this explanation to some of the arger. For instance, we should expect that if the asin of Loch Maree had been excavated by ice, it vould be a fairly uniform trough, descending from

FIG. 2.—Loch Knockie, looking North-east. From "Bathymetrical Survey of the Scottish Fresh-water Lochs."

ither end towards the middle, perhaps deepening and roadening a little near the mouth of any important ffluent. Instead of this, it is nearly blocked in that art (where it is more than double its general readth) by low islands (Fig. 1), rising from submerged plateau, and besides this, the reatest depths, about 300 feet on the western nd 350 feet on the eastern side, do not corre-pond with any marked topographical features. The act also that south of the islands is a narrow water-asin, irregular in outline, and reaching a maximum epth of 230 feet, is difficult to explain on any hypo-hesis. Loch Ness, which is almost the longest of the cotch lakes (for, with Loch Dochfour, it exceeds wenty-four miles), might seem, because of its depth—he maximum being 754 feet, fully 700 feet below sea-evel—and of its uniform slopes, to support the hypo-hesis of ice-erosion; but some evidence might have een given that its division into two basins was due nly to the deposits of the Foyers river, for the delta f the Moriston river on the northern side is more uggestive of a submerged valley.

Far from the least valuable part of the text is Sir John Murray's chief contribution—a clear and concise account of the various lakes known to exist on the surface of the globe. No abstract could do justice to this, so replete is it with interesting facts, the collection of which must have entailed great labour, for, as the bibliography shows us, they are dispersed among numerous publications. For many years to come this section will be invaluable to all students of limnology, in the widest sense of the term.

But we must conclude our notice of this encyclopædic work. We have to thank Sir John Murray, Mr. L. Pullar, and their able coadjutors for an admirable and sumptuous monograph, which, owing to the complete organisation, tells us more of the lochs of Scotland than Dr. H. R. Mill could ascertain about our English lakeland or Dr. T. J. Jehu about the llyns of Wales. We now know at least as much about them, and in some cases more, as Delebecque has been able to ascertain about the lakes of France, Forel and his coadjutors about those of Switzerland, the investigators of other European nations about the lakes of their own countries, or has yet been accomplished by energetic American surveyors on their own continent. We heartily congratulate Sir J. Murray and Mr. L. Pullar on this splendid and successful result of their labours. T. G. BONNEY.

THE WHITE MAN'S RULE.[1]

TO the great majority of people in this country the name Sierra Leone is nothing more than the vague geographical expression of a colony situated somewhere in Tropical Africa, once more familiarly known as the "white man's grave," and long regarded as the last resort of the hopelessly incompetent or the incurably vicious. That such a term of reproach is no longer applicable is shown in "A Transformed Colony," by Mr. Alldridge, whose personal knowledge dates so far back as 1871.

In a clear and attractive manner the author gives a description of the marvellous changes which have taken place as a result of the white man's rule. Situated amidst beautiful scenery, some little distance up the Rokell river, Freetown, the first settlement, now the capital and port of the colony, was originally the dumping ground for the liberated slaves drawn from all parts of West Africa; and from this collection of motley races has grown up a curious mongrel population, bound by no family or tribal ties, speaking no language of its own, and connected only by the common bond of a quaint English patois, and a paternal system of English government. To this has of recent years been added the Hinterland, peopled by numerous aboriginal tribes, each speaking its own language, preserving its own customs, and living under a more or less well-defined feudal system. As a result of the former conditions the Freetown creole has developed, a semicivilised being with a superficial veneer of civilisation, an overwhelming mass of self-conceit, and a ludicrous capacity for imitating the less desirable qualities of the European. Never is he more happy

[1] "A Transformed Colony; Sierra Leone as it was and as it is, its Progress, Peoples, Native Customs, and Undeveloped Wealth." By T. J. Alldridge. Pp. xvi+368. (London: Seeley and Co., Ltd., 1910.) Price 16s. net.

than when, clothed in silk hat and frock coat, he struts proudly to church, the observed of all observers.

On the other hand, we find the aborigine, still the

FIG. 1.—Numori. Steatite figures found in caves and supposed to be of very great antiquity. From "A Transformed Colony."

untutored savage, clothed in his loin cloth and little else, carrying out his ancestral pursuits of agriculture and war, but withal more likeable and trustworthy.

The author skirts very delicately the negro problem in West Africa (and we should have welcomed a bolder presentation of this question from one of his experience), but he does not fail to point out the evils of the purely clerical system of education which has been largely adopted in Freetown, with the result that a race of middlemen traders and clerks has arisen for whom it is becoming increasingly difficult to find employment. An interesting educational experiment is, however, being carried out in the Government school at Bo, in the Protectorate, which is of a different character, and will be followed with much interest by those who have the welfare of the negro at heart. It is intended only for the sons of chiefs, or the nominees of the townspeople, the object being to train the children to become good rulers when they grow up. There is no attempt at Europeanising them; on the contrary, it is strictly forbidden; native clothing is worn, native food eaten, native customs and institutions, so far as they are good, are encouraged, tribal patriotism is strengthened, and there is no interference with the religious beliefs of the pupils. Education proceeds on simple lines, and practical instruction in farming, carpentry, road-making, &c., is given. The results so far are encouraging, and such a scheme appears to offer the best prospects for the evolution of the negro on rational lines.

During the last few years the material development of the colony has been most striking. Railways and roads are spreading fan-like from the Port of Freetown through the "bush," carrying up the products of the Manchester looms and other luxuries of civilisation into villages where, a few years ago, the face of the white man had never been seen, and bringing back in return a rich harvest of palm oil, palm kernels, and rubber, from the hitherto untapped regions of the interior. The extent of this may be realised from the fact that the exports have increased threefold in ten years, from 290,991*l*. in 1898 to 831,259*l*. in 1907, and the revenue from 117,681*l*. to 359,104*l*. during the same period.

There is much else of interest to which only a brief allusion can be made. Mr. Alldridge draws a striking picture of the condition of the Protectorate twenty years ago—perpetual inter-tribal warfare, constant slave raiding, deserted villages with their fringe of skeletons whitening in the sun, and depopulated districts; contrasting vividly with the peaceful prosperity and commercial progress which are now to be found on all sides. But the book is full of such contrasts; on the one hand, the civilising in-

FIG. 2.—A Secret Society. A Poro boy in dancing costume, Gaura country, Upper Mendiland. From "A Transformed Colony."

fluences of the bank, the ice factory, the railway, and the telegraph; on the other, the primitive barbarism of the bush, rudimentary arts, primeval marriage

customs, the law of the Porro, the savage ritual of the Bundu, and, dominating all, the ineradicable thraldom of the fetish. It is an interesting story of the making of empire among the savage races of West Africa which will well repay perusal, and the value of the work is much enhanced by the numerous capital photographs of scenery and native customs with which it is illustrated.

W. T. P.

GEOLOGICAL NATURE-STUDY.[1]

THE sixth volume of "The Book of Nature Study" is devoted to what is styled "the Physical Environment." This, again, is subdivided into "Meteorology, &c.," written by Dr. Marion I. Newbigin, and "Geology, &c.," by Prof. W. W. Watts. The titles of these subdivisions have been omitted, curiously enough, from the headings on pp. 1 and 92. Both authors, in pursuance of the plan of the work, guide the reader towards personal observation; and Dr. Newbigin especially addresses herself to the teacher, and considers throughout how certain facts are to be brought home simply to a class. Prof. Watts's pages are therefore more closely written and more enjoyable as literature, while those of his colleague are intentionally more didactic.

Throughout Dr. Newbigin's work there is a consistent attempt to impart just enough information to excite interest, and no more. The apostles of the centimetre scale will be shocked at the willingness of the author to accept "slovenly" results. The teacher is invited to direct attention later to the difficulties that arise from careless measurement. In the case selected, however, that of the rain-gauge (p. 25), the errors would cause no difficulty at all; the results would simply be wrong at the end of a given time, and there would be no means of finding out the truth. This is just the sort of easy-going procedure that would suit the average child; but does it conduce to education? Is it not wiser to explain and illustrate methods of observation, but to refrain from records that cannot be accurate within reasonable limits? All explanations of natural phenomena have a partial character; we are always making suppositions in regard to an unknown. Dr. Newbigin, however, shows a real preference for the partial explanation, and we fear that the teacher would often have to go much further than is here indicated, when confronted with the child's persistent "Why?"

The passages on "floods," "drought and deserts," or "rainfall and vegetation," show how well the author writes and teaches, within the limits expressly imposed upon herself. Astronomical considerations, sunrise and sunset, time, summer and winter, involve more difficulty, and we cannot see our own way, in such instruction, to dispense with the good old-fashioned terrestrial globe—one, of course, without an elaborate setting, and preferably turning on a wire axis supported at one end only. Dr. Newbigin (p. 53) leaves this to a later stage and to the teacher of geography. Meanwhile, the child is instructed in

Spring issuing from Limestone. From "The Book of Nature Study."

nature-study geocentrically, and will surely soon find something to unlearn.

One point insisted on by the author, in common with many other writers, is that the atmosphere carries a "load of moisture." This phrase is, of course, singularly misleading when applied to invisible vapour, especially when the air is said to "throw down its burden" on cooling (p. 21, for instance, where this is stated in three different ways). How is the child to realise that the air, when it has done this, becomes heavier than it was before? The matter was so well treated long ago in Sir A. Geikie's "Physical Geography" that it is wonderful how it is slurred over in ordinary teaching. Surely, again, the cold surface of a hill (pp. 20 and 22) has very little to do with the formation of cloud around it. "Vapour" is used in two senses on pp. 19 and 21, where invisible vapour is postulated, and yet a cloud is said to consist of vapour. Are we not, in

[1] "The Book of Nature Study." Edited by Prof. J. Bretland Farmer, F.R.S. Vol. vi. Pp. viii+244. (London: Caxton Publishing Co., n.d.) Price 8s. 6d.

"Vorschule der Geologie. Eine gemeinverständliche Einführung und Anleitung zu Beobachtungen in der Heimat." By Prof. J. Walther. Vierte Auflage. Pp. x+294. (Jena: Gustav Fischer, 1910.) Price 2.50 marks.

"Die Vulkanischen Gewalten der Erde und ihre Erscheinungen." By Dr. H. Haas. Pp. viii+138. (Leipzig: Quelle u. Meyer, 1909.) Price 1.25 marks.

our desire to be untechnical, building in these matters without foundations, and was not Huxley's original scheme of "Physiography" a really sound guide to nature-study, even if it made its appeal to children somewhat older than those contemplated in the work under review?

Prof. Watts, at any rate, agrees with Huxley, and presupposes, in his geological section, a knowledge of the fundamental constituents of the earth. He refers freely to "silica," "carbonic acid," "minerals," "mica," and even "hydrated silicate of alumina." After all, is there more in this than is expected of the child when he is told to take one quart of milk to James Stewart of Auchencairn and one pint and a half to Mistress Campbell of Drumochter? The milk, the persons, and the farms are realities to him, and are therefore easy of comprehension. Is there any objection to making him equally well acquainted with the fundamental materials of the land? Prof. Watts gives the teacher the essential conceptions of geology, and leaves him to select what is suited to the comprehension of his class. His style is terse and vivid, and the illustrations selected by him, often from the photographs of Mr. Godfrey Bingley, are in every way worthy of the text. Since the principles of geology are so greatly concerned with the form of the earth's surface, the making of maps and models is included in the course, and the use of the plane-table, so attractive to beginners in geography, is explained and illustrated. Several of the technical terms in the chapter on the geological record, "brachiopoda," for instance, are not included in the index to the six volumes of the work; but the author moves on without hesitation—the teacher who undertakes the geological branch of nature-study must be ready to explain such technicalities to his class. Altogether, we cannot conceive a more effective introduction to geology than is here put forward.

To make two small criticisms, in the diagram on p. 210 the relations of the upper series of beds seem unnecessarily complicated by a surface-creep towards the valley on one side; and the chapter headed "Igneous Rocks" is mainly concerned with clastic rocks and earth movement. Since the conclusions stated are drawn from observation in our own islands, glaciers and volcanoes are more lightly treated than in many popular works. Prof. Watts has not gone out of his way to be popular, and has succeeded in being so in the highest of all senses.

Prof. Walther, in his "Vorschule der Geologie," has set much the same goal before himself. In five years his simple little book has run into four editions, and still forms a treatise that can be easily slipped into the pocket. The author is one of a band of German leaders in education who wish to see geology taught in all secondary (*höhere*) schools. He here leads on his reader to observe nature out of doors, and in a number of practical exercises shows the varied activities and changes on the surface of the earth. His diagrams are equally simple and convincing, whether of a tree forced to modify the form of its stem through the down-creep of a talus (p. 11), or of the formation of a granite tor (p. 29) by successive stages of decay. Even Dr. Newbigin would shake her head over Prof. Walther's rain-gauge (p. 42); but his charming directness of style gives one great confidence in his experiments. He permits us chemical formulæ, and even crystallographic systems; yet his work is quite unlike the text-books familiar in German schools. His little local sketches, such as the section of a swampy area in Fig. 30, are real lessons in geography; indeed, we have shown these pictures to a class in the field in explanation of the broad features of a landscape. We may differ with him on small points, such as his treatment o trough-faulting, which surely arises most frequentl through the faulting of a fault by one of opposit hade; but he guides us onward from our first observa tions on a hillside until we can grasp the complexitie of a geological map. He expects us to purchase on and use it, and supplies index maps for all th German surveys, with considerable lists of literature t assist our summer holidays. This confidence in th attractiveness of his subject is one of the charms o Prof. Walther's treatise; but we must remember tha he appeals to pupils trained by longer working hour than our own, and to the sons and daughters of a people that regards education with respect.

Dr. Haas, in "Die vulkanischen Gewalten," add one more to Herre's series of popular scientific mono graphs. The black-letter type, and occasional sen tences in the long black-letter style, show that it i intended for general readers beyond the colleges. I is not concerned with personal observation, but con tains, logically stated, the results of a wide range o research. The description of a volcano in time intro duces us to earthquake problems and the constitutio of the earth's interior. Though the writers referre to are naturally for the most part German, the autho has read widely, and even quotes (p. 97) Albert Brun' view that the volcanic cloud consists of salts o ammonia. This leads on to an interesting discussio of how volcanoes might be produced without th presence of water in the original igneous mass, an of Stübel's theory of the formation of calderas b magmatic expansion and subsequent sinking of th central areas. There is much in this "popular work that will be useful to the teacher of geology and the illustrations of dust-clouds and lava-flows ar refreshingly recent, after the oft-repeated woodcuts t which we have become inured.

GRENVILLE A. J. COLE.

THE MEDIUM OF CELESTIAL SPACE.

THE physicist knows well that the problems wit which he has to deal are insignificant, or a best subsidiary, when compared with the great que tions so intimately connected, What is matter? an What is æther? The astronomer, though he observ the operations of nature on a vaster scale, deals wit problems of a less ultimate character. Thus, whe he seeks to investigate the properties of that mediu in which the solar system and the stars alike a moving, he is far removed from any metaphysic abstraction, and only seeks the answer to perfect definite, concrete questions concerning the tran parency and dispersive qualities of the medium. B if the questions are concrete, they are by no mea simple, and though the last two years have seen simultaneous attack on the problem on several co verging lines, the main result has been to make u realise the immense difficulties which lie in the way a definite conclusion.

Whether there is a general absorption of light space, from whatever cause arising, is a point whi suggests itself most obviously. Without attributi any absorptive power to the æther itself, it is easy see reason for inferring that a loss of light do take place. The streams of meteors which enter o atmosphere have not always been within the sphe of influence of the solar system, but have proba come in incalculable numbers from outer space. The is a continual drain on the atmospheres of the s and planets owing to the loss of the fastest-movi molecules. The empty spaces which have been fou to exist in the midst of the densest star clouds, and t curious rifts which interrupt the continuity of certa

bright nebulæ, suggest the presence of obstructing nebulous masses such as that which was only revealed by the outburst of Nova Persei. It is thus reasonable to suppose that a sensible amount of absorbing matter exists in space. But to form a quantitative estimate of its effect is a task of which our increased knowledge makes us only the more appreciate the difficulty.

The problem would be simpler if we could accept the conditions supposed by the earlier astronomers. For them the extent of the universe was indefinitely large, and the distribution of the stars roughly uniform. Moreover, they imagined that the intrinsic brightness of all stars was nearly constant, and that the observed differences of magnitude were almost entirely attributable to the effect of varying distance. But for an effective general absorption we ought, in these circumstances, to expect the whole sky to shine with the average brilliance of a stellar surface, and Halley, in supposing otherwise, was guilty of a simple error. The truth of this was perceived by Cheseaux (1744), and later by Olbers (1823), and both astronomers inferred an extinction of light in space without estimating its amount, or even supporting it by direct evidence, rather than admit that the universe was finite. The first estimate based on these premises was given by W. Struve in his "Études d'Astronomie Stellaire" (1847), a work of great historical interest. Using the data provided by Herschel's gauges, and the counts of Bessel and Argelander, Struve concluded that light coming from the mean distance of sixth-magnitude stars suffered a loss of 8 per cent. of its intensity. But we have ceased to regard as valid the premises on which this conclusion was based. We know now that the variability of the intrinsic light of the stars is so great that distance can no longer be considered as the chief factor in determining their apparent magnitudes. There are also grave difficulties in the way of assuming that the universe extends with finite density to an infinite distance. Seeliger has pointed out that unless the Newtonian law of gravitation be modified, an infinite strain will exist at every point; and even if the smallness of the total light of the sky be accounted for by some kind of absorption, a thermal difficulty remains; for any part of an infinite and eternal universe will be, as it were, within an isothermal enclosure, and the temperature at every point will be at least 6000° C. Such considerations, and the facts of observation, have led us to abandon the idea of an infinite universe, and Newcomb asserted, not only that the system of the stars was finite, but that there was no evidence that any extinction of light in space occurred. That will not hinder us from seeking for evidence. If we possessed a knowledge of the spatial relations and the luminosities of the stars, if, in a word, we held the key to the sidereal problem, we should be in a position to assess the absorption of light in space. But without assessing the loss of light according to distance, the sidereal problem cannot be solved. In fact, the two problems are interdependent, and it may be long before a satisfactory solution is reached.

There is, however, a subsidiary line of attack possible. The absorption may be selective in its character, or, in other words, its amount may be a function of the wave-length. This will be the case if it is due to scattering by particles the dimensions of which are of the order of a wave-length of light. It is not absolutely clear that a similar effect may not be produced by the æther itself. In either case a corresponding dispersion is to be expected, and the rate of propagation will depend on the colour of the light. If any celestial phenomenon be carefully observed which is strictly localised in space and in time, the relative rate of transmission for different parts of the spectrum can be detected. Newton approached the subject from this point of view, and suggested the eclipses of Jupiter's satellites as suitable phenomena for investigation. It is well understood now that the conditions of a gradual eclipse are quite unfavourable for the detection of subtle colour changes, and the distance in this case is altogether too small. The circumstances of stellar aberration have also been invoked to set a limit to the possible dispersion. But the sensitiveness of this test is also too small, for a difference of as much as one-half per cent. in the rate of transmission would at best produce a spectrum 0·1″ in length (and this is about the estimated width of the fine micrometer wire of the largest refractors). As nothing of this order is to be looked for, a finer test must be sought. Arago conceived the possibility of detecting a change of colour in variable stars according to the light phase. Contenting himself with the simple inspection of certain variables, he concluded that there was no such effect. As a matter of fact, more careful observers have noticed a change of tint accompanying the change of brightness; but even so the natural explanation is to be found in the physical character of the stars. This illustrates the need for a cautious interpretation of results, as well as for the most careful and refined methods of observation.

A great advance in practical methods has been made recently by M. Nordmann, of Paris. His plan has been to study the light curves of certain variable stars, using the light from different regions of their spectra, in accordance with the belief that a sensible dispersion in space must produce a want of simultaneity in the respective curves. With this object in view he designed an ingenious modification of the Zöllner type of photometer. By its means the light of the star examined can be compared with an artificial star produced by condensing on a small hole the light of an Osram lamp fed by a constant current. Before entering the eyepiece, the light from both images passes through one of three liquid light filters, and thus the comparison is made in red, green, or blue light as desired. Whatever opinion may be formed of the validity of M. Nordmann's conclusions, it is fair to say that his apparatus has been admirably designed, and that much is to be expected from the systematic application of his method to the study of coloured and variable stars. Finding the atmosphere of Paris unsuitable for delicate researches of this kind, he took his apparatus to Biskra, in Algeria, where he spent several months in 1907–8. Unfortunately, the climate of this station did not fulfil expectations, owing to the prevalence of sand storms, and this fact may account for a certain want of continuity in the observations in a research which demanded continuity as a necessary condition of complete success.

M. Nordmann studied chiefly the stars β Persei and λ Tauri. But before alluding to his results, we may refer to the nearly contemporaneous work of M. Tikhoff, of Pulkowa. M. Tikhoff has conceived more than one ingenious method of attacking the problem of dispersion in space. One of these is in principle the same as that of M. Nordmann, but differs from it in employing photography instead of direct visual estimates. By using bathed plates, the region of the star examined is photographed through certain screens, which are prepared in such a way as to allow only light belonging to restricted ranges in the spectrum to be effective. Thus, an orange screen may be expected to give results comparable with those obtained by visual methods, while a blue screen will give photometric estimates in the ordinary photographic region of the spectrum. By this method M.

Tikhoff studied the variables RT Persei and W Ursæ Majoris. Some years previously he had compared the velocity curves and the light curves of the stars δ Cephei and η Aquilæ, which are well-known spectroscopic binaries and variable stars. Inasmuch as an accepted theory of the physical nature of stars of this type is still wanting, this method must be considered radically unsound. But more recently M. Tikhoff has had the happier idea of comparing the velocity curves as determined from lines in separate regions of the spectrum. Theoretically, this would seem to be the method of all those which have been suggested which is the most free from objection. But it is doubtful whether, among the spectrographic observations already made, even of the highest class, suitable material exists for the successful application of the method. It is certainly possible to criticise on definite and practical grounds MM. Tikhoff and Belopolsky's discussion of the case of β Aurigæ.

The results already obtained may be tabulated thus :—

Star	Range μμ	Lag min.	Authority
β Persei	680–450 ...	13 ...	Nordmann
λ Tauri	,, .	30 ...	,,
RT Persei... ...	560–430 ...	4 ...	Tikhoff
W Ursæ Majoris.	625–380 ...	10 ..	,,
β Aurigæ	450–400 ...	10–20 ...	,,

The third column, which alone requires explanation, contains the retardation, expressed in minutes, of some event observed in blue light over what is supposed to be the same event observed in light of greater wave-length. The event in the first four cases is the light minimum of the star, while in the fifth case it is the disappearance of the radial component of the velocity relative to the Sun. Unfortunately, we have no trustworthy determinations of the parallaxes of these stars. Pritchard's values for β Persei and β Aurigæ are near 0·06″, and M. Tikhoff himself has found the parallax of RT Persei to be insensible. Thus we can only note the qualitative agreement in the sign of the lag in all cases, which suggests that blue light is transmitted through space at a slower rate than light of longer wave-length. Yet the results are liable, even on this ground, to serious criticism, which has been expressed forcibly by Prof. Lebedew. It is not surprising that close inspection shows that the data in the case of β Aurigæ are not self-consistent. But in the other cases we cannot be certain that the observed event is really synchronous in its origin for different qualities of light. This essential condition may be nullified by the physical character of the star, as, for instance, by a selectively absorbing atmosphere of the occulting body. Prof. Lebedew is entirely right in suggesting these criticisms, but they do not prove that the medium filling space is without dispersive power; and even if this fundamental question is left open, it is to be hoped that researches will be continued on the same lines, for the ingenious methods of MM. Nordmann and Tikhoff bid fair to extend our knowledge of variable stars in a most helpful way.

Meanwhile the line of direct investigation of a possible selective absorption in space has been followed. If two stars the intensities of which are I_1 and I_2 require exposure times T_1 and T_2 in order to register images of equal density on a photographic plate, we may put (after Schwarzschild)

$$I_1 T_1^p = I_2 T_2^p.$$

A priori we might expect the same effect to be produced by the same incident energy, or $p=1$. As a matter of fact, a number of independent researches have suggested that p is much nearer the value 0·8. This deficiency in the value of p has been attributed to the properties of the photographic plate. But i occurred to Prof. Turner that the fact might have its origin in cosmic causes. He had deduced from the Greenwich astrographic results that "when the time of exposure is prolonged in the ratio of five magnitudes, the photographic gain is four magnitudes." This result, which has been reached by others in more or less the same form, is equivalent to the above statement that $p=0·8$. A number of facts connected with visual and photographic magnitudes could thus be reconciled by supposing that the small particles distributed in space actually produced a selective scattering in accordance with Lord Rayleigh's law.

It seemed as if a crucial test was at hand to try this hypothesis. It was only necessary for M. Tikhoff to apply his light-filters and to see whether the apparen law of photographic action was the same for the blue starlight which affects the ordinary plate, and for the visual rays to which the bathed plate is sensitive. The experiment was immediately made, and the first results seemed to bring a striking confirmation to the hypothesis. M. Tikhoff found that $p=0·6$ to 0·79 for the photographic rays, but that $p=0·91$ to 0·96 for the green-yellow rays. But Mr. Parkhurst of the Yerkes Observatory, who has made a specia study of the subject of photographic photometry strikes a note of warning. Under conditions apparently similar, he has obtained $p=0·88$ for the ordinar plate, and $p=0·81$ for the bathed plate with colour filter. These results go in the opposite direction and must be attributed to the different plates (Schleussne and Cramer) and filters employed. Mr. Parkhurst concludes that "if cosmical causes played any part in th matter they would be completely masked by photographic effects."

The inter-relation which has been noticed betwee the problem of absorption in space and the problem of sidereal structure has naturally engaged the atten tion of Prof. Kapteyn, who has been the mos prominent and assiduous student of the latter ques tion during recent years. He has noticed that th marked deficiency in the numbers of the fainte classes of stars is equally apparent in all directions c the sky. Unless this peculiarity is attributable to th effect of general absorption, we must suppose tha the sun is situated at the centre of the universe, an though such a thing is perfectly possible, it is nc specially probable. Kapteyn prefers to admit a absorption of light, and provisionally estimated th loss required by the hypothesis of nearly constar star-density as 0·016 of a magnitude for stars with parallax of 0·1″. More recently he has brought for ward an interesting argument of a qualitative kinc Miss Cannon's classification of star spectra distir guishes between two classes which differ only i showing greater or less relative absorption in th violet end of the spectrum. Arcturus is the type c the stars less affected, while α Cassiopeiæ is the typ of those more affected in this way. If the propert is not intrinsic in the stars themselves, stars belong ing to the Arcturus class should be nearer to us tha stars like α Cassiopeiæ. Hence the former class shoulc on the average, possess greater proper motions. Pu to the test, 45 stars of the α Cassiopeiæ division gav an average centennial proper motion 11·4″, and 2 stars of the α Bootis division gave 47·1″. Thus th idea is confirmed that the distinction is due to absor tion in space. A number of interesting points ar involved in this line of argument, and it is to b hoped that it will be further tested by extending i area of application.

Quite lately Prof. Kapteyn has published second and more extended research on the subjec In this he investigates the amount of selective absor

tion, and starts from the principle that "the phenomenon must manifest itself in this, that, *ceteris paribus*, the more distant stars will be redder than the nearer ones." As a measure of redness he employs the difference, photographic *minus* visual magnitude, derived from the Draper catalogue and the Harvard revision. It would be profitless to use direct determinations of parallax, for the material at hand is far too scanty and untrustworthy. Hence he derives the measures of distance from his own statistical discussions, which have enabled him to express the average parallax of a star as a function of its magnitude and proper motion. The necessary data have thus been found for 1433 stars, and separate equations have been formed for the different spectral classes and certain ranges of proper motion within each class. It is impossible here to follow the rather complicated discussion in detail, but the result obtained on certain simple assumptions as to the nature of the scattering of light implies a loss of

0·00867 of total light = 0·00945 of mag. for photographic rays
0·00427 ,, = 0·00465 ,, visual rays

in the case of a star the parallax of which is 0·1″, or the distance of which is 32·6 light-years. Kapteyn considers that these numbers represent lower limits, and finds no difference between galactic and extra-galactic regions of the sky so far as selective absorption is concerned.

Despite the contradictory nature of the evidence, it must be felt that the whole subject is full of interest. It is now receiving the most critical and exhaustive discussion, and the need for fresh material will stimulate original and appropriate observations. It is pleasant to learn from Prof. Kapteyn that the plan of work for the 60-inch reflector on Mount Wilson includes special provision for this line of study. Efforts directed with a serious purpose and pursued with sincerity do not go unrewarded, though the shape of the reward may not always be according to expectation.

H. C. P.

NOTES.

THE list of Birthday Honours was published on Friday last, but, as usual, men of science do not figure largely in it. Among the new Privy Councillors we notice the name of Sir William Mather, who has done much to promote technical education. The honour of Knighthood has been conferred upon Mr. H. Hall, His Majesty's Inspector of Mines for the Liverpool and North Wales district, and Dr. A. Hopkinson, Vice-Chancellor and principal of the Victoria University of Manchester. Colonel F. B. Longe, Surveyor-General of India, and Dr. R. T. Glazebrook, F.R.S., become Companions of the Bath (C.B.). Mr. J. H. Marshall, director-general of archæology in India, Mr. C. Michie Smith, director of the Kodaikanal and Madras Observatories, and Dr. M. Aurel Stein, superintendent of the Archæological Survey, Eastern Circle, are appointed Commanders of the Indian Empire (C.I.E.). The order of C.M.G. has been conferred upon Dr. A. D. P. Hodges, principal medical officer of the Uganda Protectorate, in recognition of his services in the suppression of sleeping sickness, and Prof. T. W. Edgeworth David, F.R.S., of the University of Sydney. Mr. C. O. Waterhouse, of the British Museum (Natural History), has been appointed a Companion of the Imperial Service Order.

SIR WILLIAM RAMSAY, K.C.B., F.R.S., has been elected an "Associé Étranger" of the Paris Academy of Sciences, in the place of the late Prof. Alexander Agassiz.

THE Albert medal of the Royal Society of Arts for the current year has been awarded by the council to Madame Curie, for the discovery of radium. The discovery, which was the outcome of Prof. Becquerel's researches into the radio-activity of uranium and its compounds, was made jointly by Madame Curie and her husband, Prof. Curie, professor of physics at the Sorbonne, in 1898. Prof. Curie died in April, 1906, and in May of the same year the faculty of sciences paid his widow the distinguished honour of appointing her his successor. She has since continued, on her own account, the researches she commenced in association with her husband. The Davy medal of the Royal Society was awarded to Prof. and Madame Curie in 1903, and the importance of the discovery has been fully recognised by the scientific world.

THE King has consented to become Patron of the Royal Society of Arts in succession to King Edward the Seventh, who became Patron on his accession, after having filled the office of president of the society for thirty-eight years.

THE President of the Board of Trade has appointed a committee to inquire what degree of colour-blindness or defective form-vision in persons holding responsible positions at sea causes them to be incompetent to discharge their duties; and to advise whether any, and, if so, what, alterations are desirable in the Board of Trade sight tests at present in force for persons serving or intending to serve in the merchant service or in fishing vessels, or in the way in which those tests are applied. The committee consists of the Right Hon. A. H. D. Acland (chairman), Lord Rayleigh, O.M., F.R.S., Sir Arthur Rücker, F.R.S., Mr. Raymond Beck, Captain T. Golding, Prof. F. Gotch, F.R.S., Mr. N. Hill, Mr. E. Nettleship, Mr. J. H. Parsons, Prof. J. H. Poynting, F.R.S., and Prof. E. H. Starling, F.R.S. Dr. W. Watson, F.R.S., and Mr. S. G. Tallents will be secretaries to the committee.

WITH reference to Mr. Winston Churchill's statement in the House of Commons on June 16, "that the time has now arrived when a definite effort should be made to break new ground and set up a higher standard" of safety in mines, we learn that a committee, appointed by the council of the Royal Society of Arts, and under the chairmanship of Sir Henry Cunynghame, K.C.B., is now considering the relative merits of a number of life-saving appliances which have been submitted in response to an offer, under the Fothergill Trust, of a gold medal or prize of 20*l*. for the best portable apparatus for enabling men to undertake rescue work in mines or other places where the air is noxious. The committee of the society is in communication with the South Midland Coal Owners Mine Rescue Experimental Committee, which is also conducting exhaustive inquiries with the view of discovering the most suitable apparatus for use in the South Midland coalfields.

THE King held his second Accession Court for the reception of addresses at St. James's Palace on June 22. Among the addresses presented were eight from universities and a number from learned societies. The King made special replies to the Universities of Oxford, Cambridge, Edinburgh, Dublin, and London. To the representatives of Oxford University his Majesty remarked:—"It is my desire to follow the example of my father and of Queen Victoria in sustaining and in fortifying those seats of learning on whose prosperity and influence the character and repute of our civilisation largely depend. Among them the University of Oxford, with its world-famous traditions of steadfastness and loyalty, will ever hold an honoured place." The reply to Cambridge University included the words:—"Your famous University may count

upon my sincere goodwill, and, like King Edward, I shall watch its progress and expansion with lively interest. I am convinced that you will not fail in the responsibilities with which you are charged, and that the zeal for truth, love of learning, and a high ideal of character and conduct will ever be cherished and fostered in your midst." To the Edinburgh University representatives the King said:—"It gave me great pleasure to listen to the record which you have recited of the growth and increasing prosperity of the University of Edinburgh, since the time when, as Prince of Wales, my dear father matriculated as a student. The work of the universities is of far-reaching importance to the welfare of my people, and I feel confident that every extension of the sphere of their influence will be attended with beneficent results. I shall follow with deep interest and continual good wishes the work which is being done by your university in furthering the advance of sound learning and education." The reply to London University included the words:—"King Edward watched with keen interest the continuing prosperity and progress of the London University. He understood how much the strength and reputation of our country depended upon the moral and intellectual culture of her sons and daughters. He saw with pleasure the distinction and thoroughness with which the London University invested higher education in the capital. You may be assured that the fortunes of your university will ever be near my heart, and that I shall always take a lively interest in your welfare."

Queen Alexandra received Captain R. F. Scott at Buckingham Palace on Saturday last, and expressed her deep interest in the forthcoming British Antarctic Expedition. Her Majesty presented Captain Scott with a Union Jack to be carried with the expedition, and to be planted at the most southerly point reached. A telegram from New Zealand announces that the Dominion intends to present the expedition with a quantity of coal and other stores on its arrival at Lyttelton. The *Terra Nova* left Madeira on Sunday for Simonstown, where she is due to arrive on August 1. Captain Scott is to sail from Southampton on July 16, and is due to reach Cape Town on August 2, and to leave there on August 13. The *Terra Nova* should arrive at Lyttelton on October 14, set sail on November 15 for the Antarctic, and reach the base on King Edward VII. Land on December 15.

The *Times* correspondent in Berlin states that the preliminary expedition to Spitsbergen for the purpose of studying Arctic conditions in connection with the projected Zeppelin airship Polar expedition will leave Kiel on Saturday next in the North German Lloyd steamship *Mainz*, which has been specially fitted up for the purpose. It is said that Prince Henry of Prussia, as well as Count Zeppelin, will take part in the expedition, which is expected to last some eight weeks.

According to a Geneva correspondent of the *Times*, an important Swiss scientific expedition left last week to make researches in the Cordilleras basin of the Andes. The expedition is in charge of Prof. O. Fuhrmann, of the University of Neuchâtel, and it will probably be absent two years.

Mr. Robert Newstead, lecturer in economic entomology and parasitology at the Liverpool School of Tropical Medicine, and a member of the Entomological Research Committee of the Colonial Office, has gone to Malta to investigate the problem existing there of the menace to health by the sand-fly. The main cost of the expedition will be covered by a special grant from the advisory committee for the Tropical Diseases Research Fund (Colonial Office).

The discovery of an immense reef of free-milling gold ore near Stewart, at the head of Portland Canal, British Columbia, is reported. It is stated that the reef has been traced for nearly twenty miles, and naturally there has been a great rush of miners and others to the locality.

It is stated in the *Scientific American* that a fund has been started by Mrs. E. H. Harriman for the collection of complete data on mammals and other animals in the North American continent, and that Dr. C. Hart Merriam, chief of the Biological Survey of the U.S. Department of Agriculture, is about to resign his position to take charge of the work.

A Reuter message from Algiers states that two violent earthquake shocks were felt at that place, and throughout the west of the department, at 1.30 on the afternoon of Friday last. Later telegrams received in Paris on Tuesday state that earthquake shocks continue to take place in the district of Aumale, that Dowar el Enoch suffered particularly, and that twelve lives have been lost.

We regret to learn of the death, at eighty-one years of age, of Mr. C. Greville Williams, F.R.S., author of many papers in organic chemistry, and for some years assistant to Lord Playfair in the department of chemistry of the University of Edinburgh.

The *Athenaeum* announces the death, at the age of seventy-five years, of Dr. Julius Weingarten, professor of mathematics in the University of Freiburg im Breisgau.

Mr. S. A. Stewart, whose death at the advanced age of eighty-four occurred through an accident at Belfast on June 15, was a distinguished Irish botanist and geologist, and until recently curator of the Museum of the Belfast Natural History and Philosophical Society. Mr. Stewart contributed valuable papers to the Royal Irish Academy and other scientific societies, and wrote in conjunction with the late Mr. T. H. Corry the standard work "A Flora of the North-east of Ireland," brought out in 1888. Although jointly planned, the early death of Mr. Corry a few years before publication left the chief execution of the project to Mr. Stewart. Nearly seven years later a valuable supplement was published by Mr. Stewart in collaboration with Mr. R. L. Praeger in the Proceedings of the Belfast Naturalists' Field Club. Mr. Stewart's contributions to geology were also most original and important. He was an Associate of the Linnean Society, a Fellow of the Botanical Society of Edinburgh, an hon. associate of the Belfast Natural History and Philosophical Society, and one of the founders of the Belfast Naturalists' Field Club.

The *Times* announces that a memorial to Lieut. Boyd Alexander, the explorer, who was murdered in the French Sudan in April, and his brother, Captain Claud Alexander, who also lost his life in Central Africa while engaged in scientific exploration, has just been completed at Wilsley House, Cranbrook. A sheet of water on the estate has been laid out as an exact reproduction in miniature of Lake Chad from plans by Lieut. Boyd Alexander. On the islands and banks of the lake are reproductions of thatched native huts, and there is preserved on the adjacent lawn one of the boats in which the Alexander-Gosling Expedition made its way down the river Yo to the Nile.

A complimentary banquet to some of the recipients of the Mary Kingsley medal of the Liverpool School of Tropical Medicine was given by the chairman of the

school on Saturday last, when Surgeon-General Sir Alfred Keogh, C.B., who was one of the speakers, said he had endeavoured to help science in the appointment which he had lately vacated. His special mission was to endeavour to bring into the counsels of the War Office a realisation of the fact that medicine was an applied science, and that it was not concerned merely with the treatment of disease, but with its prevention. The problem of making the tropics habitable was easy, and they could make such countries as West and Central Africa as salubrious as Liverpool if they would only take the trouble to think about it and would organise for the purpose. Medical science had also a definite relation to war. He described the work of Sir David Bruce in practically stamping out Malta fever. Thanks to applied medicine, there had been added to the Indian Army for defensive purposes last year the equivalent of two battalions.

THE Cavendish lecture will be delivered to the West London Medico-Chirurgical Society to-morrow by Sir Thomas Oliver, who will take as his subject "Empyema and some Problems Connected Therewith."

THE summer meeting of the Junior Institution of Engineers will be held in Dublin and Belfast from July 16 to 23. The proceedings are to be opened by a reception at Trinity College, Dublin, by the provost and professors of engineering, and afterwards a number of engineering works, &c., will be visited.

THE autumn meeting of the Iron and Steel Institute will take place at Buxton on September 26 to 30.

THE necessity of applying what may be called the "intensive" method of treating some questions of Indian ethnology is enforced by a paper recently read by Sir R. Temple before the Royal Society of Arts on the people of Burma, and by the discussion which followed. The authorities are at issue on the order of the invasions from which the present population resulted. Sir R. Temple thinks that the order of entrance into the peninsula was Mon-Khmer, Tai or Shan, Bama or Burmese. Sir J. G. Scott believes that the Shan, if they migrated at all, formed the third body of newcomers; but he prefers to suppose that the Shan never migrated. Again, as regards religion, Sir R. Temple treats the vast majority of Burman Buddhists as Animists, Animism taking the form of Nat worship. Mr. E. Colston, on the contrary, holds that though Nat worship may be animistic in origin, it is an integral part of Buddhism, analogous to the Deva worship in Ceylon. These two authorities are again hopelessly at issue in their views as to the period when Hindu influence became powerful in the country.

THE iron styles used for writing in India are interesting, because it is through them that the types of the present scripts have been determined, the circular class of alphabets, like the Oriya or Burmese, depending upon the necessity, in order to avoid breaking the material, of moving the style in a curve, not in a straight line, along the fibre of the palm-leaf. Mr. I. H. Burkill in vol. vi., part i., of the Journal of the Asiatic Society of Bengal for the current year describes a large collection of these styles. He arranges them in no less than thirty-seven types, beginning with the most simple form, like a porcupine quill, and gradually developing into the most intricate and elaborate shapes.

IN the June number of *Man* Mr. T. M. Joyce describes some curious wooden engraved blocks used by the Bushongo of the Belgian Congo for ornamenting their bodies on festal occasions, and for staining palm cloth and embroidery fibres with a red pigment prepared by bruising the wood of a tree known as *tukula*. They are good examples of the work of this naturally artistic race. It is remarkable that, like our mourning rings, the heir of a dead man, acting as chief mourner, distributes a number of these articles to the immediate friends of the deceased as mementoes.

A GOOD example of the rain-making chiefs, to whom Prof. J. G. Frazer first directed attention, is to be found in a paper on such functionaries in the Gondokoro district, White Nile, contributed to the June issue of *Man* by Mr. W. E. Cole. The rain-maker shows considerable shrewdness in his proceedings. He always builds his village on a hill slope, which he knows attracts the clouds. He smears himself with wood ashes, and wears a number of charms. Then he produces a pot in which he keeps his rain-stones, generally pieces of crystal, aventurine, or amethyst, found on the neighbouring hills. These, in the true spirit of mimetic magic, he covers with water, and, taking in his hand a peeled cane split at the top, he beckons towards him the clouds if his people need rain. Sometimes he maliciously diverts the rain-clouds towards some unfriendly tribe. If by chance his incantations fail, he announces that some hostile chief in the neighbourhood has stolen the rain. This often leads to a raid on the offending village, and to many broken heads.

THE Bulletin of the Johns Hopkins Hospital for May (xxi., No. 230) is devoted to an important article by Drs. Crowe, Cushing, and Homans on the results of removal of the hypophysis cerebri, or pituitary body, a small glandular organ at the base of the brain. Methods were elaborated whereby the organ could be removed without injury to the adjacent brain. In dogs the most striking features following removal are development of a state of obesity, alterations in the sexual organs and skin, subnormal body temperature, sugar in the urine, psychic disturbance, and finally death—all of them symptoms which have occasionally been noticed in man in connection with tumours of the pituitary body. The paper makes a very notable addition to our knowledge of the functions of this organ.

THE difficulty of deciding whether butter is genuine or adulterated is illustrated in a paper by Mr. G. Brownlee issued by the Department of Agriculture and Technical Instruction for Ireland. The committee on butter regulations, in their final report, recommended that in the case of any butter giving a Reichert-Wollny number below 24 the presumption should be that the sample is adulterated with foreign fats. As certain Irish butters, known to be genuine, have been found to fall below this limit, an extended set of observations was made. It appears that the chief factor influencing the Reichert-Wollny number is the lactation period of the cows supplying the milk, and that in order to get butter of a more uniform composition the calving of the cows should be distributed more evenly over the year.

THE Department of Agriculture in the Leeward Islands carries out a number of experiments on sugar-cane, the results of which for the past season are now published. Of the varieties examined, some show themselves well suited for cultivation at all the various experimental centres, while others are more limited in their range and are at their best on certain special types of soil. The manurial experiments are mainly on the ordinary lines, but some new ground is broken. Molasses has been tried as a fertiliser with results that justify further investiga-

tion. It is not clear that either nitrogen, potash, or phosphoric acid is present in sufficient quantity to account for the increased crops, and the simplest explanation appears to be that the carbohydrate furnishes additional supplies of energy for the nitrogen-fixing bacteria in the soil, and thus leads to a gain in the soil nitrogen.

THE methods of picking, drying, and packing hops in Kent are described in some detail by Mr. Arthur Amos in the *Journal of the Board of Agriculture* (No. 2). Mr. Amos writes with a complete knowledge of the subject as a hop-grower, and is also a trained botanist; the article is therefore one of considerable interest. Hop production is a highly specialised branch of farming, requiring much more capital per acre than wheat or cattle production, and it includes not only hop growing, but also drying. The oasts, or drying ovens, are familiar objects to all who have travelled across Kent. The drying is managed by a skilled workman, who remains in charge during the whole time of hop-picking, and even sleeps on the spot so that he may be at hand in case of need. A good hop-dryer is a person of distinction in the village community, and rightly so, since he can by his efforts materially influence the value of the product.

THE extraordinary interest shown by the public in poultry production at the present time is discussed in the April number of the Journal of the National Poultry Organisation Society. To a certain extent a section of the daily Press is responsible for this outburst, but the popular interest always existed even before it was recognised by the Press. The society is proposing to take as full advantage as possible of the present favourable opportunities for the introduction of cooperative methods in egg production. It will be interesting to see how far cooperation may become a factor in English rural life.

THE *Field* of June 25 contains a summary of an important paper read by Mr. Pocock at the meeting of the Zoological Society on June 21 on the scent-glands of deer and antelopes, and their bearing on the classification of those groups. The author gave reasons for regarding the Indian four-horned antelope as related to the bushbucks rather than to the duikers, while the beira antelope of Somaliland is classed with the dik-diks instead of with the gazelles, and the saiga, the chiru, and the palla are removed from the latter group to independent positions. In the deer it is considered that the form of the antlers does not constitute a trustworthy guide to affinity.

IN the May number of the *National Geographic Magazine* Mr. H. M. Smith, the Deputy Commissioner, tells some of the wonderful results which have been accomplished by the Fisheries Commission in re-stocking the depleted waters of the United States with food-fishes, lobsters, oysters, &c. Nearly forty years ago the Government realised the urgent necessity for measures of this nature, and at the present day the official system of fish-culture is stated to surpass in importance and extent that of all other countries collectively. A few States did not join in the movement, with the result that there has been a shortage in the supply of the eggs of certain species. The obvious remedy for this is the assumption by the Federal Government of supreme power in regard to fisheries. For the first ten years of its existence the energies of the commission were concentrated on the culture of the eight commonest and most valuable food-fishes. Nowadays the list is six times as large, and includes shad, whitefish, Pacific salmon, white perch, yellow perch, cod, various kinds of flat fish, and lobsters. The hatcheries also rear numerous kinds of fresh-water species. The only permanent marine hatcheries are in Maine and Massachusetts, where, to use the author's own words, such species as cod, pollock, flat-fish, and lobsters are reared and distributed by the billion. Special attention is likewise directed to the diseases of fishes, particularly cancer, for which new laboratories are in course of erection. The article concludes with an account of new fisheries and new methods of fishing discovered by the commission.

IN an article in the June number of the *Zoologist* Mr. F. J. Stubbs endeavours to explain the mechanism by which aquatic birds are enabled to maintain themselves at different levels in the water. Moorhens, it is well known, will not unfrequently maintain themselves at a considerable depth below the surface by grasping plants with their toes, and it is suggested that the same means are sometimes employed by dabchicks. It is obvious, however, that such a method will not hold good for divers, in which grasping power is lacking. The mechanism, in the author's opinion, is afforded by the presence of a layer of air held between the "feather-film"—or mesh of barbules and cilia formed by the outer layer of the plumage—and the skin. "Each of the contour-feathers is provided with a separate apparatus of muscles, whereby it can be held out at right angles or pressed close to the body. In the first case the bird would appear round and fat, in the second very slim, and there would be a corresponding change in the extent of the air-envelope, and consequently of the buoyancy of the bird. By adjusting the thickness of this layer of air between the 'feather-film' and the epidermis the bird can alter its specific gravity." It is further considered that the water-repelling property of the plumage of a duck is due to the feather-film, and not to the natural oiliness of the feathers.

WE have received a series of contributions from the Palæontological Laboratory of Yale University, reprinted chiefly from the *American Journal of Science*. This department of the Peabody Museum, which became famous through the researches of the late Profs. O. C. Marsh and C. E. Beecher, well maintains its reputation under the direction of Prof. Charles Schuchert. The most important paper is one by Dr. G. R. Wieland describing in detail the remarkable Cretaceous turtle, *Archelon ischyros,* which has now been mounted for exhibition and measures considerably more than three metres in length. A discussion of this and allied Cretaceous fossils seems to show that the curious leathery turtles are the degenerate descendants of ordinary turtles. Baron F. von Huene and Dr. R. S. Lull publish a photograph and sketch of the original specimen of the small Triassic Dinosaur, *Nanosaurus agilis*, showing that it is much less satisfactory than might be supposed from Prof. Marsh's description. Prof. T. D. A. Cockerell and Dr. H. F. Wickham describe many insects and plant-remains from the Miocene of Florissant, Colorado; while Prof. Schuchert himself discusses a series of Silurian fossils from Arisaig, Nova Scotia, carefully collected by Mr. W. H. Twenhofel.

THE "Extracts from Narrative Reports of Officers of the Survey of India," for the season 1907–8, contain an interesting account of precise levelling carried out with the American binocular level. This instrument differs from levels of the ordinary form in several important particulars. It is provided with a second telescope, through which the bubble can be viewed and the scale reading at each end of the bubble observed at the same time as the staff reading is taken. The advantage of this is obvious, as the

change in the position of the observer between the two readings, necessary in the older form of level, is almost certain to cause some shift in the position of the bubble. The staff is graduated on one face only, while the telescope diaphragm carries three horizontal wires instead of the usual single one. The two outside wires are equidistant from the centre one, and in making an observation all three wires are read. The necessity of having a second set of staff graduations on another face with a different zero and in different units is thus obviated, while the three readings form at least as effective a check against errors, and are more rapidly performed than the two required on the older system. The American instrument presents the additional advantage that the interval, as read on the staff, between the wires gives a measure of the distance of the staff from the observer. As an illustration of the precision of which levelling is now capable we may take the Bombay-Madras line. The length of this line is 806 miles, and the closing error was 0·607 foot, or about 1/100 inch per mile. A closely comparable figure could be derived from other lines. Taking another test of precision, viz. the difference in the results of two observers each making a single traverse of the same line, we arrive at a figure of about 1/20 inch per mile.

In our issue of December 23 last we briefly alluded to an interesting paper, by Mr. W. G. Reed, jun., on South American rainfall types, recently read before the Royal Meteorological Society. The author constructed a map of very large size, making use of all published data, and from an inspection of the curves it was seen that (generally speaking) there is a marked division of the rainfall into the following five types:—(1) double maximum, including the region north of the Amazon and west of Dutch Guiana; (2) maximum early in the year, including Guiana and the northern part of Brazil, except the coast region; (3) winter maximum, in the northern coast States of Brazil, also on the west side of the continent south of the equator and west of the Cordillera; (4) summer maximum, extending over central and southern Brazil, Bolivia and Paraguay, and as far south as Buenos Aires; (5) rain at all seasons, embracing the southernmost States of Brazil, Uruguay, south of Buenos Aires, and east of the Cordillera. Small graphs are drawn for stations exhibiting general types of the annual range of rainfall applicable to each of the large divisions. The author also compares his own map of seasonal rainfall with those previously published, preference being given to that by E. L. Voss contained in *Petermann's Mitteilungen*, 1907.

THE University of Wisconsin has issued an account of some instructive experiments on manuring which, while not new in principle, will be of value to agricultural lecturers. The sandy soils of northern Wisconsin are deficient in humus and in nitrogen, both of which could be applied as dung or purchased organic fertilisers. It is, however, much cheaper, and distinctly more effective, to grow a crop of clover on the soil during the previous year, and then to plough it in. The New Mexico Agricultural College has published a bulletin describing the methods of apple culture under irrigation. Apples will grow in a great variety of circumstances, and can be produced in regions lying outside the old apple belt if methods like irrigation are adopted.

THE *Electrician* for June 10 contains a supplement of 160 pages devoted to the applications of electricity to marine work. Already a large proportion of the auxiliary power required on a modern liner or battleship is supplied electrically, but the electrical engineer looks forward to the near future when electricity will play an important part in the propulsion of vessels. Three possible systems of electro-mechanical propulsion are described in this supplement. In each the prime mover is coupled direct to one or more dynamos, which in turn drive motors on the screw shafts. The great flexibility of the electrical method of transmission makes it possible to vary the speed of the vessel between wide limits without running the machinery at low efficiency. The question of the prime mover of the future is obviously an important one, and several of the writers of the articles expect the oil engine to displace the turbine, just as the turbine has displaced, or rather is displacing, the reciprocating steam engine.

A NEW petrol-electric motor omnibus, constructed by the Daimler Company, is illustrated in the *Engineer* for June 24. Two power units are fitted, one at each side of the frame under the seat line, each capable of developing 12 horse-power. The engines are of the new Daimler type, with crank shafts and frames extended for the dynamotors, by which term is meant an ordinary continuous-current dynamo which is also used as a motor. Each dynamotor is normally rated at 3 kilowatts, but has a give-and-take capacity of three to four times this rating. It is stated that on ordinary greasy roads it is found almost impossible to cause this new omnibus to skid or side-slip to any appreciable degree, and nothing in the nature of a dangerous side-slip has been experienced in 5000 miles' driving. This immunity is attributed to the following factors:—the extreme flexibility of the double-unit system; the better weight distribution obtainable by the construction adopted; the distribution of braking over the front and rear wheels, and the improved methods of braking employed; the improved co-axial pivot steering; and the comparative absence of unsprung weight. The total weight of the vehicle, complete and ready for running, is 3 tons 9 cwt., the regulations allowing 3 tons 10 cwt.

OUR ASTRONOMICAL COLUMN.

METEORITE AT BOMBAY.—Mr. W. F. Denning writes:—"Advices from India mention the fall of a brilliant fireball at Bombay on the afternoon of April 25 last, at 4.15 (standard time). One observer says the meteor flashed out three times in a descent nearly vertical, and the appearance suggested huge drops of fire from a Roman candle. A few minutes later there was a report as loud as one of the harbour guns, only more muffled, and the impression was that a big mine had exploded in the neighbourhood of Khandalla.

"At Lauovli a loud rumbling sound startled the inhabitants, the houses being shaken. Looking upward, people saw a long thin line of smoke rolling from the S.W. to N.E. across the sky. Further reports indicate that the fiery ball shot up from the direction of the sun.

"Other observers at Bombay say that the detonation resembled a blasting operation, heard for many miles around, and lasting nearly a minute. The meteor appeared as a white-hot ball, and it left a long, luminous trail. On striking the surface of the Bombay Harbour it threw up a high column of water with steam.

"At Khandalla a terrific noise was heard proceeding from the direction of Poona.

"It is doubtful whether the object really descended in Bombay Harbour, as one observer says, though it gave that impression, yet it evidently fell far beyond that spot. Directed from the S.E. sky, the radiant was probably in Leo, but the height of the meteor cannot be precisely ascertained from the data available. This is the third brilliant meteor seen in sunshine during the last nine months. Others were reported in England on October 6, 1909, and May 10, 1910.

"The region of Leo seems to be a prominent one for the supply of unusual meteors."

Halley's Comet.—In Circular No. 3 of the Transvaal Observatory Mr. Innes publishes the observations of the tail of Halley's comet recorded by himself, Mr. H. E. Wood, and Mr. W. M. Worssell during May 17–21. Small sketches showing the form of the multiple tail at various times are also reproduced. In addition to the main tail there were two fainter glows separated by some degrees from the main stream near Pegasus, but re-approaching it in the neighbourhood of Aquila. Quite unexpectedly, as recorded by Mr. Payn and other observers, the remnants of the tails persisted in the eastern sky after the comet had passed the earth, and were seen each morning until the moon interfered, after May 21; but it was obvious that they were gradually fading away. On the morning of May 20 the tail was traced to R.A. 19h., dec. 5° S., 150° from the invisible nucleus. In a letter to Mr. Innes, Mr. H. C. Reeve, of Lorentzville, states that at 5 a.m. on May 19 the magnificent main tail extended to the Milky Way, and its attendant shafts were respectively 15° and 20° long, giving the whole the appearance of a huge transparent cone into which the earth was rushing. On the evening of May 19 the whole comet was south of the ecliptic, yet on the morning of May 20 the original, branched tail was still west of the sun and north of the ecliptic.

Mr. Finlay and Prof. Rudge, at Bloemfontein, report having seen a rupture of the tail, near Aquila, take place on the morning of May 18–19, but this was not recorded by any other observers.

Photographs of the comet were taken at the Transvaal Observatory, with the Franklin-Adams star camera, on every possible occasion, and are to be discussed in a subsequent Circular; one of them is reproduced on a plate which accompanies No. 4420 of the *Astronomische Nachrichten*. The chief characteristic of all the photographs is the complicated structure of the tail. Two groups of streamers are seen on either side of the axis, and, in addition, there are several side streamers showing kinks and irregularities; the photographs, in many points, resemble many of those taken of Morehouse's comet in 1908.

The *Astronomische Nachrichten* also contains notes from several Continental observatories generally confirming the results already published.

In the *Comptes rendus* for June 20 (No. 25, p. 1659) M. J. Comas Sola gives a *résumé* of the physical observations of the comet made, visually and photographically, with the 38-cm. refractor of the Fabra Observatory, during the periods of greatest brightness as a morning and as an evening object.

The comet began to be perceptible to the naked eye, at Fabra, on April 15, and the length of the tail whilst near perihelion was about 50 million kilometres (31·2 million miles). There were distinct changes in all parts of the comet after its inferior conjunction with the sun.

Before conjunction the tail was generally bifurcated and made up of numerous long filaments, without knots or sharp bends; M. Sola suggests that this simple straight appearance was the result of the intense repulsive action of the sun while the comet was so near to it. The head was relatively small, although surrounded by very feeble and extensive envelopes; measurements of the photographs generally give 110,000 km. (nearly 70,000 miles) as the diameter of the brightest part. Generally, the envelopes were eccentrically placed in regard to the axis of the tail, a feature which was very marked on May 11. The nucleus was very bright, and its diameter was about 3500 km. (nearly 2200 miles).

After conjunction, the tail was not bifurcated; on May 30 it was like a brush of numerous short hairs, and from May 31 it appeared as an aigrette, which became modified from day to day. The bright part of the head was larger, its diameter being about 160,000 km. (100,000 miles), but the fainter envelopes were reduced. The nucleus at this time was very small, probably not more than 1000 km. (625 miles) in diameter.

Measurements of the photographs of May 30 and 31 indicate that, within two million kilometres of the nucleus, the projected matter travelled at about 23 km. per sec. In a previous note M. Sola referred to projections from the head into the tail, and to the doubling of the nucleus on June 2; also to the appearance of several rapidly moving condensations on June 4. He now suggests that these appearances were a series of phosphorescent emanations which seemed to commence about May 31, and coincided with the change in the structure of the tail. Not wishing to state definitely the nature of these *ejecta*, he calls them *globes*, and gives some measures of their apparent distances on June 4. Taking a mean, he finds for the velocity with which a *globe* receded from the nucleus, 527 km. per second. All these globes appeared to vanish at a distance of about 25,000 km. from the nucleus.

Observations of Winnecke's Comet (1909*d*).—In No. 4420 of the *Astronomische Nachrichten* Herr R. Prager gives a number of positions of Winnecke's comet observed with the 24-inch refractor of the Santiago de Chile Observatory between November 2 and December 13, 1909. At all times the comet was very faint, appearing as a circular patch of light 0·7′ in diameter, and having no tail or nucleus; after December 13 it was too faint to be seen.

Colour of Comet 1910*a* during its Perihelion Passage.—Observed at the Transvaal Observatory on January 17, the great comet 1910*a* was near the zenith, and therefore practically free from the colour-absorption effects of our atmosphere. Mr. Innes records that, under these conditions, it was identical in colour with, and almost indistinguishable from, the pure snowy-white, alto-cumulus clouds which were passing at the same time (Circular No. 3, p. 21).

THE INTERNATIONAL BOTANIC CONGRESS AT BRUSSELS.

There was a large and representative gathering of botanists in Brussels on the occasion of the International Botanical Congress on May 14–22. The inaugural meeting took place in the large rotunda at the Botanic Gardens, but the serious work of the congress was carried out in the Salle des Fêtes in the grounds of the Exposition. The important subjects of deliberation were further consideration of the rules of systematic nomenclature and a series of propositions on phytogeographical nomenclature. The rules of systematic nomenclature which were drawn up as the result of the deliberations of the Vienna Congress in 1905 left open for future discussion special points in relation to non-vascular cryptogams and palæobotany. A number of sectional committees were appointed, and their recommendations formed the subject of debate at the recent congress. The chief matter for discussion was the starting points for nomenclature in the various groups. Was the date of publication of Linnæus's "Species Plantarum," 1753, which had been adopted as the beginning of nomenclature for seed-plants and ferns, to be the universal starting point throughout the plant kingdom, or would it be preferable to take the date of publication of later systematic works dealing with the various groups of cellular cryptogams?

After some informal discussion among the workers in the groups in question, a series of recommendations was agreed to by the congress. The date 1753 was accepted as the starting point for the Mycetozoa, Algæ (excepting certain groups to be noted below), Characeæ, Sphagnaceæ, Hepaticæ, and Lichens. The exceptions to the general rule for the Algæ were as follows:—Desmids, J. Ralfs, "British Desmidieæ," 1848; Oedogoniaceæ, K. E. Hirn, "Monographie u. Iconographie der Oedogoniaceæ," 1900; Nostocaceæ, M. Gomont, "Nostocacées homocystées," 1890, and E. Bornet and Flahault, "Nostocacées hétérocystées," 1886–8.

For the Fungi, Fries "Systema Mycologicum," 1821–32, was adopted as the point of departure, excepting for the Uredineæ, Ustilagineæ, and Gasteromycetes, which it was agreed should date from Persoon's "Synopsis," 1801. For Mosses, Hedwig's "Species Muscorum," 1801, was agreed upon. In order to reduce to a minimum changes of names which would result in cases where an early date was adopted as a starting point, special committees were appointed for each of the large groups to draw up lists of *nomina conservanda*, or names of genera which, from long-established use, should be retained, though inadmissible on grounds of strict priority. These lists will be put

before the next congress of 1915; in the meantime, workers are recommended to make as few changes as possible from generally accepted nomenclature. The discussion of a starting point for the nomenclature of Bacteria, and of the Schizophyceæ, excepting the Nostocaceæ, was postponed until the next congress of 1915.

A useful decision was arrived at in connection with the names of pleomorphic fungi, the successive states of which have been described under different names. It was agreed that these should bear one generic and specific name, viz. the earliest given to the state, which it is agreed to call the perfect state, on condition that this name otherwise conforms to the rules. The "perfect state" is that which leads up to the ascus in the Ascomycetes, the basidium in the Basidiomycetes, the teleutospore in the Uredineæ, and the spore in the Ustilagineæ. The addition of figures, including microscopic details, was recommended when describing new genera or species of fungi.

In palæobotany some difficulty has arisen from the use of the same genus name for recent and fossil plants. In order to reduce to a minimum changes of name resulting from this cause, it was agreed to draw up a double list of generic names which are to be retained:—(1) a list of the generic names of living plants, duly published and in general use, which enter into competition with earlier names of fossil genera, such as Bucklandia; (2) a similar list of generic names of fossil plants which compete with earlier homonyms of living plants, which have been relegated to synonymy, in order to avoid the future use of such names for the living plant. In the former case the name of the living plant takes precedence, in the latter that of the fossil.

The palæobotanists showed some disinclination to fall into line with workers in descriptive botany generally in making use of a Latin diagnosis when describing new genera or species. It was, however, pointed out that a diagnosis, giving merely the important characters of the fossil in question, was required, and not a complete description; and, further, that such a diagnosis rendered the form in question far more widely intelligible than a description in a vulgar tongue. Those members who were present at Vienna in 1905 called to mind the difficulty experienced when attempting to limit the number and variety of vulgar tongues which should be admissible for the diagnosis of novelties. It was agreed that a Latin diagnosis should be given, with the recommendation to the author to add a full description in a vulgar tongue.

The last matter for discussion was the proposition to add to the list of *nomina conservanda* for seed-plants. The original list, which was agreed to by the Vienna Congress, was admittedly incomplete, but as it had been accepted and used for five years many botanists were disinclined to amend it. A list of additions was proposed which, if accepted, would have upset again changes made since 1905 in conformity with the rules. On the other hand, the new list contained names of large and important genera, such as Persea, which could only be retained if included in a list of *nomina conservanda*—on strict grounds of priority they are inadmissible. It was decided to remove from the list those names of genera the inclusion of which would be subversive of changes already made, and with this important alteration the additions to the original list were agreed upon.

Dr. John Briquet, upon whom as Rapporteur-Général has fallen the brunt of the work of the section of systematic nomenclature, was persuaded to continue in office for the next five years until the congress of 1915.

The Vienna Congress had also appointed a commission of eminent plant-geographers to draw up recommendations for phytogeographical nomenclature. The reporters of the commission, Profs. Flahault and Schroeter, drew up a report embodying their own views and those of other workers upon various aspects of the question, and also a series of recommendations based on the consideration of the views and suggestions put forward. These recommendations were accepted by a large majority of the commission, and formed the subject of debate at the congress. It was recognised that the congress should not attempt to pass laws or rules, but merely recommendations supported by reasoned annotations. It became evident, however, that a general agreement on the recommendations as a whole was not likely to be reached, and the reporters therefore decided to put before the congress only those recommendations upon which there appeared to be substantial agreement. The substance of these was as follows:—

(1) That every author should explain exactly what he understands by the terms he uses.

(2) That the popular names of units of vegetation in the various languages should be retained.

(3) That the principle of priority in phytogeographical terminology is inadmissible.

(4) That a polygot synonymic dictionary of phytogeographical terminology with bibliographical references should be compiled by a special commission.

(5) That the colour scheme suggested by Prof. Engler for maps of tropical vegetation be recommended for adoption.

(6) That ecological phytogeography may be defined as the study of the relationships of plants and plant-communities with their environment.

These recommendations were carried *nem. con.* As regards the somewhat contentious question as to the meaning and definition of the two terms *plant-association* and *plant-formation* which have come into use to designate the most important units of vegetation, Prof. Flahault stated that there appeared to be general agreement in considering the *association* as a unit of definite floristic composition and the *formation* as something different from the association.

Though it has not resulted in the establishment of a uniform system, the work of the commission has been of the greatest use in forcing workers to think about the concepts and terms they employ and in promoting international exchange of views; the promised synonymic dictionary will be invaluable.

An invitation to the congress to meet in London in 1915 was accepted.

At the conclusion of the congress many of the members went on to Berlin to visit the new Royal Botanic Garden and Museum, at the invitation of the director, Prof. Adolf Engler. The spacious new gardens, with the commodious plant-houses, museum, and herbarium, which have been arranged by Dr. Engler at Dahlem, fifteen minutes by rail from Berlin, have replaced the older, smaller, and less convenient institution in the Grunwaldstrasse, Berlin. A special interest attaches to the gardens and museum at Dahlem. Starting *de novo* with the advantage as object-lessons of the great botanical institutions throughout the world, Dr. Engler has organised a garden and museum on thoroughly scientific lines, and embodying the ideas of a great systematist and plant-geographer. It was a great privilege to be conducted through the grounds and buildings by Dr. Engler, with the help of Prof. Urban, the assistant-director, and other members of the staff, and in the glorious summer weather which prevailed at the end of May the gardens showed to the best advantage. The arrangement is strictly scientific and educational, a small space only being devoted to mere ornamental gardening. A large portion is arranged on the lines of plant-geography. Here we find a representation of typical German forest-land and other Central European formations, and, so far as space and climatic conditions permit, illustrations of the vegetation of widely different areas both in the Old and New Worlds. A most striking feature is the Alpine section, or Alpinum. Miniature mountain ranges have been thrown up, as far as possible to scale, and formed of the natural stone, and planted with the characteristic species and plant associations of the mountain area in question; an attempt has also been made to indicate altitudinal distribution. The student is thus able to make himself acquainted by an object-lesson, to some extent, at any rate, with the flora of the Swiss Alps, the mountains of the Caucasus, or the Himalayas. Miniature streams and waterfalls add to the effect.

Another section is devoted to biology and morphology, while another forms a systematic teaching collection, with facilities to enable the student to work at the plants on the spot. Medicinal and economic plants have also their section. A great part of the area is devoted to the arboretum, a fine collection, though still young, as work on the gardens was only begun about fourteen years ago. The plant-houses include a fine tropical house illustrating

a tropical landscape, with a wonderful lawn of *Selaginella Kraussiana*, and forming the main feature in a four-sided series of smaller houses devoted especially to aroids, tropical dicotyledons, tropical orchids, other tropical monocotyledons, tropical ferns, various succulents, Cactaceæ—these last two forming a particularly fine collection—tropical economic plants, tropical water and marsh plants, Cape plants, subtropical Australian plants, and others; also a large temperature house and numerous culture houses. The museum contains a spacious herbarium and a number of fine exhibition galleries, including sections devoted to biology, systematic botany, palæobotany, plant-geography, and economic botany, also a section illustrating the products of the various German colonies. In addition there is a large lecture theatre, a laboratory, and a number of work-rooms. The whole forms a magnificent example of botanical organisation and enterprise.

On the following day opportunity was given for visiting the State School of Horticulture and the Biological Institute for Agriculture and Forestry, both adjoining the Botanic Garden.

An interesting and enjoyable meeting closed with a pleasant excursion on the Wannsee to Potsdam, arranged by the Union of Systematists and Plant-geographers. This included a visit to Sans-Souci and the Royal Park and Gardens under the guidance of Director Fintelmann.

A. B. R.

AN ENGLISH PHILOSOPHICAL CONGRESS.

ON Friday and Saturday last, June 24 and 25, joint meetings of the Aristotelian Society, the British Psychological Society, and the Mind Association were held at 22 Albemarle Street, London, at which subjects of wide philosophical and psychological importance were discussed before large and interested audiences. The discussions were based upon papers previously printed and circulated among the members of the several societies. On Friday afternoon the problem of "Instinct and Intelligence" was considered on the basis of papers by Messrs. C. S. Myers, C. Lloyd Morgan, H. Wildon Carr, G. F. Stout, and Wm. McDougall; Saturday morning was devoted to the discussion of the question, "Are Secondary Qualities Independent of Perception?" on the basis of papers by Messrs. T. Percy Nunn and F. C. S. Schiller; and the congress was brought to a close on Saturday afternoon with papers on the nature and development of attention, by Mr. G. Dawes Hicks; the "faculty" doctrine: outline of some experiments on school children in relation to this doctrine, by Mr. W. H. Winch; and some observations on the æsthetic appreciation of colour combinations, by Mr. E. Bullough.

I.—*Instinct and Intelligence.*

Dr. C. S. Myers maintained the view that instinct and intelligence are inseparable in all forms of mental activity, animal and human alike; that they are respectively the objective and subjective aspects of the same thing, viz. mental process in general and in its various particular manifestations; and that instinctive behaviour, while characterised by mechanism in its objective aspect, is from the point of view of the experiencing subject characterised by finalism. He criticised the two assumptions commonly made with regard to instinct as a form of mental process distinct from intelligence, viz. that in instinctive behaviour as such there is no awareness in the individual's consciousness of the end to be achieved, and that such behaviour is fixed and from the beginning perfect. He pointed out that an instinct is to be distinguished from a mere reflex or chain of reflexes by (1) a feeling of activity, and (2) a vague awareness of the result of the instinctive action *before* the action is actually performed, both characteristics being present in the very first manifestation of the instinct. These rudiments of conation and meaning are essential constituents of any activity deserving the characterisation "instinctive." Observations of instinctive activities in insects and other animals do not justify the view that such activities are "perfect the very first time," or that they exhibit undeviating uniformity; "even ants are capable of learning from their elders," and this power is generally regarded as a sign of intelligence. The common view that man has few instincts compared with the lower animals is partly accountable for by the fact that "he is never aware that he is acting instinctively." His inner or subjective acquaintance with those activities pronounces them to be of the nature of intelligence.

Lastly, from the more general points of view of evolution and philosophy, the finalistic interpretation of the evolution of mind, and indeed of the entire universe, is the necessary complement and essential correlative of the mechanical interpretation, if our thought is to be saved from that pure abstraction—purposeless mechanism.

In conclusion, neither are instincts identifiable with reflexes, nor do they form a third class in addition to those of reflexes and intelligence. Summing up in Dr. Myers's own words:—"According to my view and my use of the words, instinct regarded from within becomes intelligence; intelligence regarded from without becomes instinct."

Prof. Lloyd Morgan agreed with Dr. Myers so far as to admit that the two factors, instinct and intelligence, "are present in the most intimate relationship throughout very nearly the whole range of animal behaviour as exhibited by those organisms in which the central nervous system has reached a sufficiently high level of development and differentiation to justify the use of the words 'instinctive' and 'intelligent.'" In his view, "the instinctive factors depend entirely on how the nervous system has been built up through heredity under that mode of racial preparation which we call evolution; intelligent behaviour depends *also* on how the nervous system has been modified and moulded in the course of that individual preparation which we call the acquisition of experience." (Dr. Myers suggested in the course of the discussion that this was genetic rather than psychological analysis.)

Prof. Lloyd Morgan illustrated his views by means of a somewhat detailed account of the experience of a young moorhen chick, and gave as a brief definition of instinctive behaviour, behaviour which is "practically serviceable on the occasion of its first performance," thus including within its scope reflex action so far as this is accompanied by consciousness. He also referred to the behaviour of the Yucca moth, and to the stinging of prey by the solitary wasps, as instances of instincts performed once only in the lifetime of the individual, where learning by imitation, &c., was impossible. He considered that the element of intelligence supervened in originally instinctive behaviour by the introduction of "meaning" through "factors of revival," though he emphasised the fact that "this is every whit as much the outcome of the innate potentiality of the moorhen as the originally instinctive performance." If instinct be identified with innate potentiality, all intelligent behaviour involves an instinctive element.

Mr. H. Wildon Carr considered the problem from the philosophical standpoint, and gave a detailed exposition of Bergson's views, which he supported by arguments for the most part metaphysical. He refused to identify natural dispositions or tendencies with instinct, and for this reason found himself unable to agree with Dr. Myers's view. He emphasised the contrast between the very complicated instinctive activities of ants, bees, &c., many of which cannot by any possibility have been learnt by individual experience, and the more pronounced cases of intelligence in man, and, reminding his audience that "instinct and intelligence are not observable facts, but interpretations," proceeded to show how the two terms represent two distinct lines of evolution of animal life, along each of which there is to be found no tendency towards evolution in the direction of the other. Along one, instinct evolves at the expense of intelligence; along the other, intelligence evolves at the expense of instinct. "The fundamental difference is one of kind, and lies in the mode of apprehension of reality, and the kind of knowledge that serves the activity of each. It is this essential difference that accounts for the degree of consciousness or unconsciousness, plasticity or fixity that characterises each, and not *vice versa*. . . . It is not a scientific but a metaphysical distinction, which rests on a criticism of the nature and limitations of intel-

lectual and instinctive knowledge." Intelligence is a knowledge of the relations of things, instinct is a direct insight into their inner nature. Bergson has employed the word "sympathy," in its technical sense, to represent this kind of knowledge. In Mr. Carr's view, mechanism and finalism are mutual contradictions, resulting from the limitations of merely intellectual knowledge.

Prof. G. F. Stout agreed with Dr. Myers, as against Prof. Lloyd Morgan, that every instinctive action as such is determined by intelligence, for the reason that the very first performance of an instinctive action involves intelligence. Adopting provisionally Prof. Morgan's own criterion of intelligence as "learning by experience," he showed that the learning must take place on the first occasion and not on the second (where the second is the presentation of a situation similar to that of the first, but to which the animal reacts in a different way owing to its previous experience). "On the second occasion the lesson is utilised; but in order to be utilised it must already have been learned." Unless there is mental reference beyond the immediate present there can be no intelligence, but such reference cannot be furnished by mere revival of past experience itself lacking reference. Conation, or the felt tendency towards an end, which, equally with the cognitive aspect, is present in the first performance of an instinctive act, forms the basis of attention and initiative which contributes to the "future reference" above-mentioned, and also definitely marks off instinctive action from merely reflex action.

Prof. Stout rejected Mr. Carr's view that instinct is a peculiar way of knowing, distinct from intelligence, his reason being that he could "find nothing in the instinctive behaviour of animals which cannot be accounted for by the combination of certain purely biological adaptations with psychical processes marked by intelligence fundamentally akin in nature to all other intelligence." He sided with Prof. Morgan against Dr. Myers in thinking that use of the term instinct should not be extended to cover all cases of inherited nervous organisation conditioning the development of intelligence, but that the word should be used "to mark off a distinct kind of connate endowment," viz. congenitally definite modes of behaviour; but he supplemented Prof. Morgan's criterion of definiteness (definite enough to be "practically serviceable on the occasion of its first performance") by saying that the congenital definiteness referred to was "a definiteness such as would require to be explained as the result of learning by experience or conscious contrivance, if it were not directly provided for by inherited constitution of the nervous system, as determined by the course of biological development." What non-instinctive congenital endowment provides for is "a special capacity for acquiring skill and knowledge," itself dependent on interest and retentiveness. It is marked endowment in this direction which distinguishes genius from ordinary ability.

In Stout's view, instinct "is mainly confined to animal life, and in the life of animals it has a two-fold function. On the one hand, it is a substitute for learning by experience. On the other, it has an educative value as a condition of learning by experience; it has this value inasmuch as it provides an animal with the experiences which are useful to it, and thus enables it to learn just what it requires to learn. In the case of human beings, this function of instinct is, in the main, superseded by instruction. All that either instinct or instruction can do is to supply appropriate experiences. How this material will be utilised depends on other factors."

Mr. William McDougall found himself for the most part in close agreement with Dr. Myers and Prof. Stout. He regarded instinctive processes and intelligent processes as of essentially similar nature, as involving the same fundamental modes of mental activity, but considered that "we can properly and usefully distinguish between mental processes that are conditioned wholly or mainly by innate dispositions on the one hand, and on the other hand such as are conditioned by dispositions that have been largely built up through the experience of the individual," and that "the words instinctive and intelligent may properly be used to mark this distinction." He objected to Stout's use of the designation intelligent for every process which is *capable* of producing modification of innately determined modes of behaviour, even when such modification is not, as a fact, brought about. Intelligence is only operative when a modification is effected. Thus the Yucca moth, laying its eggs in the Yucca flower on a single occasion in its life, may be said to perform an act which is purely instinctive, having no admixture of intelligence. Prof. Bergson's view of instinct, presented by Mr. Carr, is not supported by the facts. The work of Dr. and Mrs. Peckham on solitary wasps has shown that instinctive activities are far from being perfect and invariable in nature, and that they may be combined with a (seemingly) high degree of intelligence. In Ammophila the capacity for acquiring and acting upon detailed knowledge of locality is found developed to an extraordinary degree. This development of intellect is all the more remarkable when we consider at what a disadvantage the higher insects are placed compared with the higher mammals in being deprived of all the advantages for training of the intelligence given by a period of youth (play, &c.).

Bergson's use of the term sympathy does not seem very appropriate or helpful in many actual cases of instinctive activity, *e.g.* that of the paralysing wasp.

Lloyd Morgan's view that the strictly mechanical interpretation of natural processes is the only one permissible to science forces him to the identification of instinctive action with compound reflex action, and causes him to ignore the extremely important conative character exhibited by the process.

The criterion of being "practically serviceable on the occasion of its first performance" is not sufficient to mark off instinctive activity from reflex action on the one hand, and from intelligent behaviour on the other.

The small part assigned by most psychologists to instincts in the development and functioning of the human mind is surprising and difficult to understand. Especially is this the case with regard to Prof. Stout's system of psychology, and its explanation would seem to be that Stout limits the application of the term instinct to forms of mental process expressed through innately coordinated motor mechanisms. "Now all our mental processes manifest themselves through the agency of preformed motor coordinations, innate or acquired. For Stout, then, as for me (McDougall), instinctive process can be marked off from other modes of behaviour only by reference to the origin of some part of its conditioning factors in the innate constitution of the organism. For Stout the innate factors by which it is marked off are the motor mechanisms only by which the mental process manifests itself in bodily movement; for me they are also and chiefly the innate disposition by which the whole instinctive mental process is conditioned." The specific conative tendency exhibited by each instinctive process is a far more important and characteristic feature of the process than the operation of innate motor coordinations. The only reason why Stout selects the latter rather than the former as the differentia of instinctive process is "because the more essential feature, the specific conative tendency, continues to reveal itself at all levels of mental development and throughout the life of the human mind, while the innate motor factor comes clearly into view only in instinctive processes that are relatively pure."

Another characteristic of purely instinctive activity which Stout has failed to note is the existence of an unmodified innate perceptual disposition which conditions the perception evoking the instinctive reaction. Such innate perceptual dispositions continue to be active in the adult human mind, though undoubtedly modified and differentiated through experience.

McDougall summarised his view of instinct as follows:—"A typical example of a purely instinctive action implies the existence in the creature's innate constitution of, first, a specialised perceptual disposition; secondly, a specific conative tendency that is excited when this perceptual disposition is played upon by the appropriate sense-impression; and, thirdly, some coordinated system of motor channels through which the conative tendency works towards its satisfaction. The three things belong together; each implies the other two; each can subserve the life of the organism or of the species only in conjunction with the other two; all three together constitute a functional unit which is transmitted as such from generation to

generation; and to such a functional unit of the innate constitution only, and to no part of it alone, and to no other fact or feature of the organic world, can, I submit, the name instinct be properly applied."

II.—*Are Secondary Qualities Independent of Perception?*

Dr. T. Percy Nunn maintained in his paper "(1) that both primary and secondary qualities of material bodies 'are really in them, whether anyone's senses perceive them or no'; (2) that they exist as they are perceived; and (3) that sensations, as mental entities exercising a representative function, need not, therefore, be postulated." He attacked the view that there are elements in experience (*e.g.* tooth-ache) whose being consists "only in being experienced," and these are therefore psychical in nature, showing how the (false) belief in their psychical nature arose. In place of this view he advocated a form of the theory of realism which he considered to be more consonant with the facts of science and immediate experience, and which involved the theses above-mentioned. He devoted much space to the consideration of the problems of error and illusion as they appeared from this point of view.

Dr. F. C. S. Schiller criticised Dr. Nunn's theory of realism from the point of view of pragmatism, and endeavoured to show that all his arguments were based upon pragmatical postulates. He also considered critically the senses in which the words *independent, extramental, reality*, had been used in the paper, and to what extent the theory advocated could be regarded as a metaphysical one.

III.—*Psychological Papers.*

Prof. G. Dawes Hicks criticised the views of attention which made it either, on the one hand, "a unique faculty" or "mode of mental energy" having presentations for its objects, or, on the other hand, a property of the presentations themselves regarded as independent and interacting with one another. He advocated the treatment of the problem of attention from the genetic point of view, and urged that the attempt should be made to form some conception of the conditions under which attention became possible in the primitive mind. After a consideration of the various factors influencing the attention process, such as feeling-tone, intensity of stimulus, &c., he traced the gradual growth of voluntary attention and indicated the relation of attention to willing and to the consciousness of self.

Mr. W. H. Winch discussed the value of the "faculty doctrine" in the light of experimental results obtained in the investigation of different forms of memory, accuracy, &c. The results of investigations into the transfer of practice effects, in which the method of "equal groups" was employed, were given, and were shown to prove slight transfer in the domain of memory, but none in that of accuracy, the improvement in the allied function being so small, even in the former case, compared with the improvement in the medium of training itself, as to make the balance of evidence against the "faculty doctrine."

Mr. E. Bullough described a series of observations made on a large number of individuals as to their preferences for colours, when seen in pairs, and the reasons given by the subjects themselves for such preferences. The two methods of (A) appreciation and (B) production were employed, and the material used was coloured silks. The subjects were found to belong to the following "perceptive types":—(*a*) objective type; (*b*) "physiological" type; (*c*) "character" type; (*d*) associative type. Definite relations were shown to exist between these perceptive types and the various criteria of preference or rejection of pairs of colours, such as "balance," "unification and dissociation," "consonance and dissonance," &c.

The societies dined together at the Criterion Restaurant on Friday evening, Prof. W. R. Sorley being in the chair. In the course of the after-dinner speeches the important suggestion was made by Prof. S. Alexander, and accepted with acclamation by the company, that the Aristotelian Society should strive to become the representative society of English philosophers, much as the Chemical Society, the Physical Society, &c., represent English science in those subjects.

WILLIAM BROWN.

THE MOTION OF THE MOON.

THE *American Journal of Science* for June contains an interesting article in which Prof. E. W. Brown discusses possible causes for the want of agreement between the moon's observed motion and theory. In his second section Prof. Brown gives a summary of these outstanding discordances:—(1) a secular acceleration $2''$ greater than that due to the change of the eccentricity of the earth's orbit round the sun; (2) a term of 300 years' period and coefficient $15''$; (3) a term of 60 years' period and coefficient $2''$.

The secular acceleration is usually ascribed to tidal friction. Prof. Brown considers certain hypotheses as to the origin of the three-hundred-year term. He takes no further notice of the sixty-year term. It is quite possible, however, that the secret will be ultimately revealed by the term of shorter period, for if we assume that the forces required for the two terms vary as the coefficients and inversely as the square of the periods, it appears that the force required for the smaller term is the larger; moreover, the period of the sixty-year term is already known with a smaller percentage of error, and the next few years' observations will accentuate this consideration in its favour.

The fourth section of the paper lays down the fundamental rule which controls this detective problem. Any hypothetical cause must be dismissed from consideration that would produce a motion in either perigee or node above thirty seconds of arc in a century. Here Prof. Brown is at least as cautious as there is any need to be; he might have said fifteen seconds instead of thirty.

The sixth section dismisses from consideration the figure of Jupiter, the cumulative effect of the asteroids, and light pressure. Imperfections in the calculated theory seem to Prof. Brown inconceivable, and those who have followed his work will agree with him.

The seventh section raises the hypothesis of an equatorial ellipticity in the sun's figure. There is no direct evidence of such an ellipticity, and, moreover, it becomes necessary to assume that the period of rotation of the sun must be of a length that can be specified to its hundred-thousandth part. It is true that this period lies between the extreme values that have been determined from observation of the photosphere, and these values differ by six parts in a thousand; but it is clearly a large assumption to take 1·00000 (five zeroes) as the true value of a quantity of which all we are entitled to say is that it probably lies between $1 \pm 0{\cdot}003$.

The eighth section deals with magnetic hypotheses. The discordance between theory and observation in the moon's motion is not due to the secular motion of the magnetic axis of the earth, but it is possible to frame hypotheses as to the moon's magnetism that cannot be dismissed as impossible.

The conclusions of the ninth section, dealing with the moon's libration, are very similar in character to those of the preceding section. Some hypotheses can be ruled out, for they involve librations that would have been already detected by observation, but other hypotheses remain tenable for the present, in particular a long-period libration of fifty seconds.

THE TRAINING OF ENGINEERS IN FRANCE.[1]

IN a lecture published in the *Revue générale des Sciences* for April, M. André Pelletan compares the training of engineers in France with the similar training given in the United States, England, and Germany. He devotes himself more particularly to the courses of study provided for those intended to occupy the highest engineering posts.

In so far as the lecture deals with the courses elsewhere than in France, there is, naturally, little that is new in his paper, but his statement in regard to the training given in the École polytechnique will cause surprise to those not well acquainted with the work of that important institution.

It appears that students enter about the age of seventeen, as soon as they have passed the French equivalent for an English matriculation examination (the *baccalauréat*).

[1] "La Formation des Ingénieurs en France et à l'Etranger." By André Pelletan.

They then commence the preparatory course, which occupies, on the average, not less than three sessions, for, although 22 per cent. of the students complete preparatory courses in two sessions, 45 per cent. take three sessions, 27 per cent. four sessions, and 4 per cent. five sessions. This preparatory course comprises mathematics, chemistry, mechanics, and physics, as well as modern languages; it extends over about seven months in each year, and the course is repeated year by year. M. Pelletan thinks that to make a student follow the same course for an average of three years must frequently tend to make him rather stupid. According to him, the course in mathematics is much too theoretical in its character; the students spend too much time on analytical geometry; they deal too much with abstractions and too little with problems involving realities and actual numbers; as a result, their attempts to apply the mathematics they have learned lead to results, not only false, but actually absurd.

When the student has completed his preparatory course he spends two years on the more advanced courses, making a total of five years' study. A very large part of his time is devoted to higher mathematics, as is shown by the fact that about 36 per cent. of the marks awarded for purposes of classification are given to this subject, while mechanics and machinery receive about 26 per cent., physics about 21 per cent., chemistry about 20 per cent., astronomy (!) about 9 per cent., architecture about 2 per cent., history and literature about 4 per cent., German about 4 per cent., drawing about 5 per cent., and military subjects about 5 per cent. According to M. Pelletan, a large part of the mathematical course is simply a repetition of the work done before.

The amount of time spent on practical work is absurdly small; none is mentioned in the case of mechanics and machinery; only six lessons are given in physics and eleven in chemistry; on the other hand, the physical welfare of the students is treated more seriously, for they receive eighty lessons in horsemanship, sixty-four in gymnastics, forty in fencing, and sixteen in boxing.

Students are allowed little liberty; they are under military discipline, have little leisure, and are required to spend a considerable time in drill, &c.

According to M. Pelletan, the result of this is that the most mediocre students, provided they are gifted with a good memory, come out first in the list and receive the best positions; in all that concerns "red tape" they are perfect, but they lack initiative, for they have never been allowed to think or do for themselves.

It is not for a foreigner to criticise French methods, many of which, as the writer well knows, are admirable, but if the premier engineering school of France is conducted on the principles set forth in this paper, there is certainly ample room for that reform which the author demands. The present writer has ventured to suggest to the director of the École polytechnique that a reply should be made to this indictment of his institution.

J. WERTHEIMER.

REFRIGERATION.[1]

A SHORT account of the first International Congress on Refrigeration appeared in NATURE of October 2, 1908, and served to indicate the important position which refrigeration has taken in the fields of technics and commerce.

The bulky volumes before us, in which communications appear in their original French, English, German, or Italian, fully confirm that view. The subjects discussed range from magneto-optic investigations on liquid hydrogen, through the preparation of cooling agents to the law of the transport of chilled food; from the use of liquid air in mining to its use for increasing the efflorescence of bulbs.

These 200 communications vary very much in character. Some are *résumés* of well-known work at low temperatures, others compilations by authors who appear to have been ignorant of the work of others in the field, and to have thought it necessary to fill their papers with elementary transcriptions from text-books.

[1] Premier Congrès international du Froid, Paris, Octobre 5–12, 1908. Tome i., Comptes rendus, pp. iv+700. Tomes ii. and iii., Rapports et Communications. Vol. ii., pp. iv+1009+ii; vol. iii., pp. iv+963+ii; illustrated. (Paris: Secretariat-Général de l'Association du Froid; London: 3 Oxford Court, Cannon Street, n.d.) Price, 3 vols., 25s.

The vast majority, however, are new and valuable additions to the subject. Many are the results of prolonged and careful experimental research on questions such as the industrial separation of oxygen and nitrogen from the air, the specific heat of certain salt solutions, the conductivity of insulators under experimental and under practical conditions, and both relatively and absolutely. Naturally much attention was paid to the preservation of food of all kinds, both on land and at sea. In this connection the particularly complete investigations from America on the physiological effect of cold storage for varying times and at varying temperatures on poultry are specially noticeable. This paper is accompanied by really beautiful photographs of sections, and quite disposes of the notion that cold storage has any bad effect on nutritive values if maintained at the proper temperature and followed by careful thawing in dry air. Many other communications discuss the same question less exhaustively with regard to other food materials. In this connection it is noticeable that, on the whole, the standard of the English papers was below that reached by those from the other great countries. Happily, this defect was to a large extent made up by the colonial communications; but this does not fully atone for the want of any official notice of the congress by the Boards of Trade and Agriculture. The difference is particularly marked with reference to America, and is only an indication of the want of interest these departments take in the fields which they are supposed to represent. Another question which appears in several communications in various forms is that of suitable units for the refrigerating industry. It is extremely desirable that some agreement should be arrived at which would be internationally acceptable. As a result of these deliberations an international bureau has been formed, which has come to some agreement, and which will submit recommendations to the next congress at Vienna in October, 1910.

FRANCIS HYNDMAN.

UNIVERSITIES AND TECHNICAL TRAINING.[1]

PERHAPS the most noteworthy educational event of modern times was the origin and development of the Universities of Berlin and Bonn. After the Battle of Jena and the humiliating Treaty of Tilsit, after the closing of the University of Halle by Napoleon, at a time when Prussia had sunk under the heel of Bonaparte to the rank of scarcely a third-rate Power, the King, influenced chiefly by the brothers Wilhelm and Alexander von Humboldt, determined to look to higher education as a means of retrieving his country's fortunes. Such was, and still is, the faith across the Rhine in the practical value of education to the State. Napoleon got his Treaty of Tilsit, but there were men by the side of the Prussian King with great ideas, men who with stern and far-seeing determination forged weapons which, during the hundred years which have passed since then, in the field, in the laboratory, and in the *Seminar*, have made Prussia, have made Germany, what they are to-day.

The mediæval university as it developed in England held residence, in the sense of actual living together in seclusion, as an essential condition of study. The modern university, following the almost universal practice, required residence indeed, but residence only in the sense of working and thinking together, in science in the laboratory, in literature and philosophy in the *Seminar*. The faculties of the mediæval university were retained—theology, law, medicine, and philosophy—music and other technical subjects were left outside to the care of special schools. The mediæval university, as we have seen, had behind it the accumulated prestige of centuries; the modern university had no such individual advantage; it built upon the common educational history of mankind, and adapted itself with the greatest freedom to the requirements of the time. There is much wisdom in the saying that a university is born old. The mediæval university was a centre of dogmatic teaching; research, if not explicitly discouraged, was practically discouraged by the fact that general culture, the training of the judgment, was aimed at, not specialised learning; a recent Cambridge writer puts the object as "not how to keep our trade, but how to keep our souls

[1] From a lecture delivered before the Royal Dublin Society on March 9 by Prof. A. Senier.

alive." The modern university broke away from this entirely, its ideal being research, with absolute freedom. Paulsen, in his well-known work on "German Education," says:—"Scientific research cannot possibly be regulated by decrees of the ruling powers, but can only thrive in full liberty: to find aims and objects, means and ways of speculation and research, must be left to individual initiative." The teaching of sufficient preparatory knowledge, chiefly in languages and mathematics, was left to the secondary schools, these having long attained to a very high degree of efficiency in Germany. Thus the modern university became a research university, the object of study, according to Paulsen, being "the ability to think scientifically, that is to say, the ability to comprehend and test scientific researches, and to conduct them; and in the second place, to solve practical problems on the basis of scientific knowledge." This ideal, which includes both the pursuit of pure science and its technical applications, was realised to the greatest degree in the philosophical faculty. The results were sometimes great and sometimes small, but were always honest attempts to do something toward the advancement of knowledge.

To be successful in research it is necessary to confine the attention to special departments of the subject of study, to specialise, and to become acquainted, at first hand, with the work of previous investigators, their difficulties and failures, as well as their final results, obtained in the original records published in the scientific journals of their respective countries—not from inhuman text-books or mechanical indexes. Every large research laboratory consists of a little army of specialists who consult one another in the subjects in which each has special knowledge, just as in ordinary life one consults the physician, the lawyer, or the engineer. Next, success depends largely on imaginative capacity. This should be strengthened by every available means. Many find strength in poetry, fairy-tales, the Arabian Nights, in music—for by the scientific method, conjectures, hypotheses, have to be invented, to be subjected to rigorous experimental or other testing, and to be abandoned, modified, or established as they are found to conform, or not to conform, to nature. Again, everything should be done to awaken and to cultivate natural curiosity respecting the unknown: the leader, the teacher, should never miss an opportunity to direct attention to possible new developments. Prof. Appell, of the Sorbonne, recently defining a man of science, said he did not mean "the man who knows," but the man who "combines with his knowledge scientific activity, that is to say, a curiosity always alert, indefatigable patience, and, above all, initiative and again initiative."

In the foregoing paragraphs I have endeavoured to indicate the conditions essential to the success of research, to the success of a research university—conditions from without, contributed by the community, by the State, a suitable environment; and conditions from within, properly trained leaders and students to follow them, afterwards to carry on the leadership. Thus, as to the first condition, Wilhelm von Humboldt in a State paper, in 1810, says:—"The State should not treat the universities as if they were higher classical schools or schools of special sciences. On the whole, the State should not look to them at all for anything that directly concerns its own interests, but should rather cherish a conviction that, in fulfilling their real destination, they will not only serve its own purposes, but serve them on an infinitely higher plane, commanding a much wider field of operation, and affording room to set in motion much more efficient springs and forces than are at the disposal of the State itself." As to the second condition, in the selection of leaders, of professors, Paulsen tells us that "proficiency in some branch of scientific research was regarded from the first as the principal requirement, aptitude for teaching coming into consideration only in the second place, although it would be more correct to say it was taken for granted that a prominent scholar who had distinguished himself in scientific research was always likely to make the best and—in the last and highest resort—the most efficient teacher." Professors and students gathered in the Prussian capital, the work of the laboratories and the *Seminare* began—men like Fichte, Schleiermacher, and Wolf; Mitscherlich and Rose; later, Hegel, Böckh, the brothers Grimm, Scherer, Bopp, Niebuhr, Ranke, Savigny, and Eichhorn; Mommsen, Virchow, Helmholtz, and Hofmann, and so many others, did therein their life's work. The work of these men, their glorious example, is felt to-day, either directly or through their students, throughout the world of learning. There is scarcely a university or college now in existence in which, not one, but many workers look back directly or indirectly to Friedrich Wilhelm's university in Berlin with gratitude and with affection.

To trace the effects of the research university, which after Berlin and Bonn became universal throughout German countries, though of absorbing interest, cannot be undertaken here, even in outline; but the result in two directions must not be passed over altogether—first, the effect of habits of research on our general views of education; and, secondly, the extraordinary rise of chemistry in the nineteenth century, directly ascribable to it. As to the first point, it has gradually come to be recognised that work in research has an educational value to the worker, quite apart from its value in other respects, as awakening and strengthening what is noblest and of greatest utility in man, which places it at least on an equality with the older studies peculiar to the mediæval university. The thoughtful student can hardly enter a research laboratory without feeling that he is entering a place sacred to the wondrous mysteries of nature—a place where, when he has attained the requisite knowledge and dexterity, he will be permitted to put questions to nature, and, it may be, see something of those mysteries revealed. An explorer famous for his achievements will take him by the hand, and will in the friendliest manner direct him, will tell him what to do and where to go. He will lead him at first along some short and well-worn paths; he will then allow him to venture on longer ones, but still worn with footsteps, which he will recognise as those of former students, who subsequently became great explorers; then little by little he will be encouraged to go out alone into paths less known, until in time he will wish to push on, to extend his wanderings into unknown regions, a little at first, but afterwards more and more, to seek his own way, into regions of wondrous and, to his imagination, of unlimited possibilities; and the reception by the old explorer and the others, on his return, is a pleasure so exquisite that it exceeds any possible description. In most of this wandering he is associated with his fellow-explorers, who have like aims and like aspirations—men whom to know and to work with is the highest form of education.

The second point to which I wish to allude, as a direct result of the establishment of research universities, is the great development of the science of chemistry during the last century. Just before and about the beginning of the century there were three centres of notable activity in chemistry; one was in England, another in France, and the third in Sweden. The work of these served to lay the foundations of the science: in England, by Priestley, Black, Cavendish, Dalton, and Davy; in France, by Lavoisier, Berthelot, and Gay-Lussac; in Sweden, by Bergmann, Scheele, and Berzelius. With some important exceptions, the work of these chemists was isolated; they did not train students or found schools of after-workers; they owed little, almost nothing, to universities—the research university had not arisen. But the exceptional students were indeed important—men of genius who in any circumstances would have forced their way: Faraday, the student of Davy; Wöhler, the student of Berzelius; and Dumas, and, above all, Liebig, the students of Gay-Lussac. Dumas in Paris and Faraday in London worked practically by themselves, and their great discoveries are well known: they were generals of the highest genius, but without an army; but it was reserved for Liebig, and his great collaborator Wöhler, who both returned to Germany, there, with the splendid environment of the new research universities, to be instrumental in founding organic chemistry, and raising the science generally to the high position it attained. A further example of the indebtedness of the world to the brothers von Humboldt is the interesting fact that Alexander von Humboldt was the discoverer of both the French Dumas and the German Liebig: his influence it was that induced Dumas to leave the apothecary's shop in Geneva to go to Paris to Gay-Lussac; and it was by his interest, too, that the German

student Liebig was brought to the notice of the great Frenchman. At Giessen Liebig founded the first chemical laboratory—indeed, the first science laboratory—open regularly to students; there, and afterwards at Munich, he conducted his great researches, and trained the research students who continued his work, and who themselves or their successors still continue it in all countries. Without the research university all this would have been impossible.

A few words must be devoted to Napoleon's experiment in founding a university centralised in Paris, and doing no teaching or research of any kind. One of the effects of the Revolution was the abolition in 1793 by the Convention of the ancient universities of France. The effect on education was disastrous. To remedy this, Napoleon, in 1806 and 1808, determined to establish an examination university for the whole of France; and this university, once established, continued until our own time, and has only recently been abandoned in favour of the German type. The University of London, founded in 1825, was of the Napoleonic type, for well-known reasons; and the Royal University of Ireland followed on the same lines. All this has now happily been changed, in Paris, in London, and in Dublin; and they must be few who would urge to-day that education by examination can lead to anything but failure to literature, to science, or to the State.

Realising with Carlyle that "the end of man is an action, not a thought," the research university has always recognised that the end of learning is not itself, but the benefit that it confers on its own votaries and on mankind. Thus Liebig was alert to the applications of his scientific discoveries and to the possession on the part of his students of the special talent necessary, the aptitude, for making such applications efficiently. Liebig's first inquiry, on fulminates, led to the modern manufacture of those substances and generally to the explosives industry. Similarly other researches either originated or improved almost every industry of the last century into which chemistry enters. His concern throughout his life for the requirements of medicine, of agriculture, of our food supply, and the enormous advances to which his discoveries led, need not be recapitulated. Hofmann himself, who perhaps more than any of Liebig's students realised his master's ideal, and became, after Liebig, the greatest scientific teacher of his day, came to England in 1845 to take charge of the newly founded Royal College of Chemistry. For twenty years he worked in London with well-known results to science and manufactures and to the training of research chemists and teachers. It was the time of the Great Exhibition, and it seemed as if chemistry was transferred to England. But the environment was not congenial. We had no research universities. Humboldt's universities were too great an attraction. Palaces for research were built for him, first at Bonn and finally at Berlin; and, naturally, the great research teacher re-crossed the Rhine. The industries which otherwise might have been ours followed him, and, directly or indirectly, the great rise of chemical industries in Germany, of which we hear so much at the present day, is to be ascribed largely to the work of this wonderful man and the surroundings of the research university. Hofmann continued the practice of Liebig in entrusting to those of his students who gave evidence of having the requisite capacity the application of his scientific discoveries. At least one of the large colour works in Germany was thus indirectly connected with the university laboratories in Berlin. This was a labour of love on the part of his students; but it led eventually to the enrichment alike of master and pupil, to a degree that professors in these lands can only envy. Thus the research university, splendid as were its achievements in pure science, never lost touch with technology; and there can be no question that this was to the advantage of science itself, quickening it by contact with the concrete conditions of real life, and justifying it by a worthy object.

But it gradually became apparent that there was an important field of research between the discoveries of pure science and their actual use in manufacturing processes. This was recognised as a field of work somewhat different in its point of view from that of pure science, but, like the latter, requiring the highest degree of knowledge and skill. It has been conveniently termed technical research. For example, there are many more coloured compounds known than dyes; but some of these might be converted into dyes if the requisite conditions could be discovered by which changes could be effected in their molecular structure in accordance with well-known laws. Again, the synthetic formation of indigo, of the structure which chemists imagine to represent its molecule, though long known as a laboratory experiment, was until recently economically impossible as a manufacturing operation. To overcome this difficulty, with a faith akin to that of the Humboldts in the success of their universities, one of the large industrial undertakings in Germany set to work with its little army of technical research chemists, and after years of patient labour, and the expenditure of three-quarters of a million sterling, the reward has been success. The demand for this technical research work has grown in Germany as it has in no other country. The large industrial undertakings have their own laboratories devoted to it, and, in addition, the practice has become general of retaining, at substantial salaries, the interest of the university professors, for the advantage of particular manufacturers. German professors of chemistry are now princes indeed compared with their position in the time of Liebig. But all this has not been sufficient to meet the demand for technical research work and for trained workers; and there has arisen a new class of high school, the technical research university, of which that at Charlottenburg may be taken as a type. These new institutions, by the standard required for entrance, and by the quality of the work they do, are entitled to take, and do take, rank equal to the university, and they confer a doctorate in engineering.

We have now considered four types of institutions for the advancement and diffusion of learning and of its applications to society—institutions of acknowledged university rank: of the mediæval or residential college university, exemplified by Oxford; the research university, as seen at Berlin; the examination university, first known in Napoleon's University of Paris; and the technical research university, as seen at Charlottenburg. In England, where numerous new universities have been established in recent years, the type adopted has been a combination of the German research university and the German technical research university, the one or the other type predominating according to local needs, and the whole adapted to its surroundings, particularly to the conditions of secondary education. Whatever view may be held respecting the German practice of separating these two types, as adapted to German conditions, it will, I think, be generally agreed that, for the conditions which prevail in these islands, the combination of the two in the new universities is a wise arrangement. Our two new universities in Ireland are also of this combined type, and are to be adapted to Irish educational conditions and the needs of the country.

Two advantages the German university has which are not found in this country: the one is the *Seminar*, the other the coordination between the secondary school and the university, which relieves the university of all work except research and preparation for research. In science the influence of Liebig, through his students, was so great that science laboratories, after the model of Giessen, have become the recognised attribute of science professorships throughout the world; but the corresponding laboratories for literature and philosophy are with us entirely wanting. No doubt the work is done here in a less organised and different way, but the institution of organised and properly equipped *Seminare* would be an important advantage to the literary, philosophical, and other departments of our universities. The second advantage referred to possessed by the German university is the character of the leaving examination of the secondary school. It corresponds to our matriculation examination, with the added knowledge acquired by about two years' university study in arts, and its acceptance by the university as evidence of sufficient knowledge for matriculation relieves the university of that most unfortunate practice, so common here, of giving the student an examination as his first experience on entering. The student in "Faust" who said, "Zwar weiss ich viel, doch möcht ich Alles wissen," would have been surprised

had his first experience been an examination. The higher matriculation standard in Germany, and the fact that the German student is older—the average age is twenty to twenty-five years—on entering the university, must be borne in mind when comparisons are made as to the proper time for specialisation and research to commence.

If we desire to rival the work of the German universities, we should seriously attempt the better organisation and coordination of our entire educational system. One might imagine a trunk railway with stopping-places and branches. The trunk line might represent pure science, literature, and philosophy, and be always extending itself further; the stopping-places to where the scholars or students branch off to apply their training to livelihood occupations. Where exactly these stopping-places should be placed should be fixed after careful deliberation. Most would branch off for the arts and crafts from the primary school; most of the remainder would branch off after the secondary school; a small proportion would enter the university, branching off for the professions at places decided upon. Encouragement to enter the university should only be given after careful consideration. Far too many men nowadays are painfully struggling against nature in the university, to the detriment of the occupations for which nature really equipped them. Even in the German Empire only 13 out of every 1000 of the male population enter the university.

The *Times*, in a recent leading article, says:—"Germany has built up a chemical industry, worth tens of millions of pounds annually, through the agency of research chemists, methodically trained in her numerous technical schools." This is quite true; but there is one further requirement that must be mentioned: German manufacturers know the value, in dividends, of the services of trained research chemists; Irish and English manfacturers do not; and no matter how many and how well trained our university students become, the effect on the country's industries will be small unless they find suitable fields of operation. This is a serious and fundamental question which might well be taken up by industrial improvement movements and by anyone who has the ear of the public.

RECENT DEVELOPMENTS IN TELEGRAPHY AND TELEPHONY.[1]

FOR many years the simple form of Morse apparatus or its equivalents served the requirements of most countries, but as the telegraph service grew and the traffic rendered it imperative to erect long lines directly connecting distant cities, the problem of obtaining a greater revenue from the large capital expenditure involved became pressing, and progress was made broadly on three distinct lines of development. In the first, means were designed for the transmission of several messages simultaneously over the same conductor; in the second, by the use of suitable mechanical and electrical devices, the actual speed of transmission was raised in overhead wires to ten or twelve times that possible by manual operating, and, finally, type printing and writing systems were invented with varying degrees of success.

A method which in theory admits of sending as many as twelve simultaneous messages in one direction, or double that number if duplexed, depends on the superposition of musical vibrations on a telegraphic circuit at one end of a line. To effect this result, a number of electrically driven tuning-forks, arranged to vibrate at different frequencies, are connected through telegraphic keys to a line wire, so that on depressing any one key a series of electrical vibrations, of the frequency of its companion tuning-fork, are sent through the line. At the far end the receivers are of a type that will respond to musical vibrations only, and each receiver is constructed or adjusted to respond to the vibrations of one of the distant tuning-forks alone, and to no others. If any one key is depressed a simple musical oscillation traverses the line, and the receiver in tune responds. If two or more keys, however, are depressed simultaneously, a series of compound curves is transmitted, and those receivers that are in tune with the various components of the curves respond, and all the others remain unaffected. This system originated in America, but it has been developed and improved by Mercardier in France, where it is said to have given good results recently. In the modern apparatus the receivers consist of so-called mono-telephones, each of which is so made and adjusted as to respond to only one frequency.

The second method of increasing the output of telegraphic wires is the automatic or machine-transmitting instrument, which is typified by the Wheatstone apparatus adopted and perfected by the Post Office in Great Britain. In all instruments of this character a long paper ribbon is perforated by a suitable machine in an arbitrary manner, and the transmitting and receiving apparatus is so designed as to transcribe these perforations, at the distant end, into Morse signals, into similar perforations, into type-printed messages, or even into written characters.

This Wheatstone system has been very fully developed in the United Kingdom. It is capable of dealing with traffic at a maximum rate of 450 words per minute, and it is invaluable for the transmission of news. Thus, in the central office in London, items of news may have to be transmitted to fifty or more towns simultaneously. Circuits are made up for news transmission, each providing for a number of towns, some of the circuits being of a permanent character and some formed temporarily to meet special requirements. As many as eight Wheatstone slips can be punched simultaneously in one operation, and each length of slip is run through the necessary transmitters at the highest speed considered judicious. When long Press messages are received they are divided into sections, and each section handed to a separate telegraphist for perforating, so that the transmitting apparatus can be kept to its maximum capacity. Without this useful and adaptable apparatus, it would be almost impossible to deal satisfactorily with the vast amount of news traffic which is sent daily to every town in the country.

For ordinary public message traffic on lines of moderate length, where each individual message is short, the Wheatstone has certain disadvantages, namely, the initial delay in perforating the slip, its distribution, and, finally, the re-distribution of the received slip amongst the writing telegraphists, for it is obvious that at the high speed at which Wheatstone is worked, several operators are required at each end of the line to keep pace with the apparatus. In practice in this country, for circuits of moderate length it is generally considered preferable to provide direct Morse apparatus worked simplex, duplex, or quadruplex, as circumstances may dictate.

With overhead lines the limit of speed in automatic working is that imposed by the receiving apparatus, which, owing to its self-induction, obstructs the reception of Morse signals at a higher speed than that named. This difficulty has been overcome by substituting a chemical for an electromagnet receiver. In this form the current at the received end passes through a long paper ribbon saturated with a solution which is decomposed by a positive current. The Morse signals appear in blue lines on the received slip.

It is said that with this method a maximum speed of 1000 to 1200 words is possible under favourable conditions, but the difficulty in working at such high speeds, where characters are received in Morse code and have to be transcribed manually, is the division and distribution of the slips amongst the large number of writers necessary to keep abreast of the work, the precautions needed to avoid loss of messages, the injurious effect of brief contacts caused by workmen, which result in the loss of several words, and last, but not least, the difficulty and delay in obtaining repetitions where errors, false signals, or missing words render this necessary.

All the foregoing methods increase the carrying capacity of the wires; in other words, they reduce the capital expenditure per message, but none of these increase the output per operator, nor do they diminish the working cost in the instrument-room; in fact, with high-speed automatic transmission this cost may be higher than with other methods described. The messages have to be prepared by the perforation of the punched slip, telegraphists have to control the sending and receiving apparatus, and the Morse slips, as they are reeled off the receiving apparatus, have to be divided and distributed amongst a number of operators for transcription. The initial pre-

[1] From the "James Forrest" Lecture, delivered before the Institution of Civil Engineers on June 22 by Sir John Gavey, C.B.

paration of the transmitting slip will always, of course, be necessary in all automatic systems, but inventors have turned their attention to increasing the speed and reducing the cost of transcription at the received end, in the case of manual as well as automatic sending, by the substitution of typing apparatus worked mechanically or electrically for the manual transcription. A very considerable number of instruments has been designed to achieve this end, but one of the earliest, which has met with permanent success, and by means of which a very large proportion of the work in Europe and nearly the whole of the Trans-continental work is dealt with, is the well-known Hughes's type-printing instrument.

The Hughes method of transmission has many advantages. It provides a clearly typed message for delivery instead of a written one, it removes a possible source of error in transcription, and it increases the speed of working as compared with Morse by about 25 per cent. It can be duplexed, and it is used by the Post Office on all its Continental wires. It has, however, the disadvantage that a considerable interval of time elapses between the transmission of two consecutive signals owing to the revolving arm having to traverse all the intervening letters. Baudot has obviated this waste of time by adopting the multiple system of telegraphy. He entirely abandons the Hughes method of transmission, and he forms an arbitrary signal code which, by means of five consecutive currents, some plus, some minus, in combination, he represents each letter of the alphabet, figures, or other signals. By his method he can provide four or six channels simultaneously on one wire, each being worked manually.

The Baudot system admits of the transmission of a much larger number of messages over each wire than the Hughes. It is also more flexible, inasmuch as the various channels it provides can be divided amongst an equal number of towns; thus Paris can use two channels to Lyons and two to Marseilles over a Paris-Lyons circuit extended from Marseilles, and so on. It is largely used in France, and has been introduced into this country.

It will have been observed from the foregoing that there are three distinct methods of telegraphic transmission with which we are mainly concerned to-night, although others might be mentioned. In the first, an arbitrary code of signals is repeated in similar arbitrary signals by which the alphabet is artificially represented, and the message is read by a skilled operator; in the second, what may be termed the dial type of apparatus is used, where two type-wheels, either moved mechanically or electrically, revolve isochronously, and they may either show fleeting letters or print them in permanent characters; and in the third, an arbitrary set of electrical signals is devised which actuates specially designed apparatus which may reproduce the message in legible characters, printed, or even written. The third method has been utilised by various inventors and applied to automatic transmission, so as to dispense with manual transcription at the receiving station.

In all cases a paper ribbon or slip is perforated by punches generally actuated by a specially designed type-writer keyboard, in which the depression of any key causes a series of perforators representing the arbitrary combination of the corresponding letter to appear on the slip. This is passed through an automatic transmitter; the electrical currents corresponding with the perforators are transmitted over the circuit, and the distant apparatus actuated.

Murray has devised a system which has undergone lengthy trials both at home and abroad. His slip has one row of perforations which gears into the moving mechanism of the transmitter, and below this a second series of perforations which represent his artificial signalling code, which is of the Baudot type. At the receiving apparatus an exact counterpart of the transmitted slip with its perforations is reproduced, and this perforated slip is passed through and actuates an automatic type-writer, which prints the message.

Creed has worked in the same direction, but he uses the ordinary Wheatstone alphabet already described, and, of course, the Wheatstone transmitter. At the receiving end a perforated Wheatstone slip is reproduced by a punching machine, which, controlled by the reverse currents from the transmitter, and, using compressed air as a motive-power, perforates the received slip at considerable speed. This slip is then passed through an automatic type-writer adapted to work with the Wheatstone alphabet, which types the message on a long slip, to be gummed on the telegraph form. In both these cases the received slip can be inserted in a second automatic transmitter and the message sent on to another town—an advantage in the transmission of news, which frequently has to be re-distributed from large provincial centres to other towns having no direct communication with London. Both these systems are in use in the British Post Office.

Siemens and Halske in Berlin have devised an automatic system in which, by means of suitable apparatus, the message is printed by the receiving apparatus direct by photographic methods.

Writing telegraphs, based on the fact that two ordinates at right angles to one another can be made to describe any curve, have been designed. The telewriter, in which the pen is connected to two arms which follow the movements of the writer, and which in doing so pass over varying resistances and transmit to line currents of varying strength, is well known. At the receiving end two pivoted electromagnets, placed in a very powerful magnetic field, are deflected over arcs dependent on the strength of the current circulating at any moment. Two arms at right angles to one another are connected to the transcribing pen, one arm being pivoted to each magnet, and the writer's movements are reproduced.

There is only time to refer briefly to the beautiful writing apparatus designed by Pollak and Virag. In this a slip is perforated by suitable means with nine rows of holes of varying sizes; suitable flexible brushes make contact through these holes between batteries and the line wires, and thus cause currents of different electromotive forces and duration to circulate over the line, and to act on two telephone receivers at right angles to one another. Rays of light are reflected from one to the other and on to a photographic slip, and the written messages, which can be transmitted at 600 to 1000 words a minute, appear developed and fixed on the sensitised paper which emerges from the dark closet of the apparatus.

Submarine telegraphy is not susceptible of the many developments that have been possible with land-lines. The high electrostatic capacity, varying from 0·3 to 0·4 microfarad per mile, and the very long lengths that are necessary to connect the great continents of the world, rendering the use of any but the most delicate apparatus impossible on long cables. The receiving instruments originally invented by the late Lord Kelvin, then Sir William Thomson, are still the only apparatus available for the reception of messages on long Transcontinental cables, and so far it has not been found possible to increase materially the speed of working except, of course, by increasing the dimensions and cost proportionately.

In ordinary telegraphy, when transmitting through an overhead line, the frequency of the current alternations is only 180 per second for 450 words per minute, and the current has actuated the apparatus at the further end before the battery connection has ceased. Another condition, however, is introduced when a conductor is used for telephonic speech in which a maximum frequency of 1800 to 2000 vibrations per second has to be dealt with. In these cases the transmission from the telephone assumes complex wave-forms, and the effect of even a moderate capacity becomes far more marked than in the case of telegraphic transmission. If a simple wave impulse were emitted in a circuit containing neither capacity nor inductance it would maintain its form, and it would only lose in amplitude owing to the waste of energy in heating the conductor. With much capacity in the circuit, however, the wave tends to elongate, and if the capacity be sufficiently great and the line sufficiently long, the following wave overtakes the lagging tail of the previous one; they blend more or less together, and having lost their distinctive character they fail to impress on the receiving telephone the distinct character of the sound from which they emanate.

The loss of the overtones means diminution of the timbre of the voice; in other words, through speech may still be possible, but the voice ultimately becomes less recognisable until, when a certain limit is passed, if the

resistance of the conductor be not too great, it may degenerate into a low-toned imitation of speech, or with the smaller conductors which are used for city work the attenuation rapidly lowers the volume of sound until it becomes unrecognisable. Self-induction is the analogue of inertia in mechanics; therefore, if it were possible to endow the circuit in which a wave was in movement with sufficient self-induction to prevent the tailing and consequent distortion of its form, the limit of speech would be materially increased, as the attenuation due to resistance alone would have to be provided for. Now it is possible to achieve this result to a certain extent by adding artificially to the self-induction of telephone cables, technically termed loading. The ideal method would be to increase the self-induction uniformly throughout, and attempts have been made to effect this by lapping a copper conductor with thin iron wire or tape of a high magnetic permeability. Another method consists in distributing magnetic coils at uniform distances of a mile or two apart throughout the length of the line. Under these conditions the distance over which speech is possible has been increased from two and a half to three and a half times.

The British Post Office has recently laid a cable with distributed inductance between England and France which will increase the range of speech about four times as compared with a similar type of unloaded cable.

The rapid and enormous development of the telephone service that has taken place throughout the world within the last few years is a remarkable achievement of the electrical engineer. The principle of the microphone, which converts sound vibrations into electrical vibrations, and of the telephone, which re-converts the electrical into sound vibrations, are so well known that I need not dwell further on the subject than to point out that Graham Bell's telephone, as it left his hands in 1876, is essentially the same instrument, slightly improved in mechanical construction, as he gave it to the world, but all the other adjuncts of a complete telephone service have been profoundly modified, and we are not yet in sight of finality.

In the period during which the ordinary telephone equipment has undergone modifications, inventors have turned their attention to the design and perfection of an automatic telephone in which each subscriber, by a simple method of manipulation, may without the intervention of an operator at the exchange obtain direct access to any other subscriber connected with the service. One of the earliest systems of this type was known as the Strowger. Each subscriber's line terminates on a line switch which forms part of a group of 100 switches. This switch is connected by ten circuits, the equivalent of the plugs and cords in a manual board, with a series of selectors each accommodating 100 junction lines. According to the size of the exchange, there may be two or three sets of selectors connected similarly by means of junction circuits, and, finally, there is a connector, a somewhat similar instrument, which makes the connection between the two subscribers.

Each telephone has a dial with finger holes and numbers. On removing the telephone from the hook the procedure is as follows. If, say, No. 4852 is wanted, the caller inserts his finger in hole 4 and revolves the dial up to the limiting stop. This actuates the line switch, which causes a connecting plug to enter the springs of the first disengaged junction leading to the selector group of 4000. The same action follows in sequence with 8, 5, and 2, the final movement of the connector making the connection if the required subscriber is disengaged. If he be through to another a busy back signal (a vibratory current) is given. When the connection is made and the conversation is complete, the hanging up of the telephones restores the connections to the normal. This method has had considerable development amongst the independent telephone companies in America.

On the subject of the future development of telegraphs and telephones, few of those acquainted with the subject would venture to dogmatise, but certain statistics I have prepared will convey to you possibilities far more pregnant than any amount of speculation. The following figures, for the years 1902 and 1907 respectively, have been gathered from authentic returns, and they embrace information from every country of importance throughout the world:—

Telegraph and Telephone Statistics—Wire Mileage.

	1902	1907	Increase
Telegraphs			
Land wires	3,659,659 ...	5,038,981 ...	1,379,322
Submarine cables	212,894 ...	259,000 ...	46,106=21·6%
Telephones			
Wire	7,467,417 ...	19,839,537 ...	12,372,120
Subscribers' stations ...	3,534,036 ...	8,406,336 ...	4,873,330

Large figures frequently fail to impress the mind, but when it is stated that this mileage of wire will soon, if it has not by this time, equal one-third the distance from the earth to the sun, the remarkable activity of the modern telegraph and telephone service will perhaps be more forcibly realised.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The engineering department is losing the services of Mr. F. H. Hummel, lecturer in civil engineering, who has accepted the chair of engineering at Belfast, and of Dr. J. D. Coales, lecturer in electrical engineering, who has been appointed principal of the Wolverhampton Technical School.

CAMBRIDGE.—The observatory syndicate, in a report to the Senate on the Huggins dome and the astrophysical building, state that the buildings now erected may be regarded as consisting of two parts, though for the sake of economy in construction they are structurally blended. The first part consists of a dome 23½ feet in diameter, together with a small room for accessory apparatus and a room for any observer who may be making use of the Huggins instruments installed in the dome. These are to be called the Huggins dome and the Huggins observer's room. The second part—the astrophysical building—comprises a computing room, which also serves as a library, and a small room appropriated to the use of the head of the department. The Huggins instruments are now ready for adjustment and use.

The Goldsmiths' Company have given 700*l.* for the equipment of the metallurgical department of the chemical laboratory.

The prize of 50*l.* out of the Gordon Wigan fund for a research in chemistry has been awarded to Mr. J. Thomas, Trinity, for experimental investigations on "The Isolation of the Aromatic Sulphinic Acids" and "The Resolution of Externally Compensated Quinoline Derivatives containing Two Asymmetric Carbon Atoms."

Mr. W. F. Penée, of the Indian Forestry Service, will deliver a course of lectures on Indian forestry during the Michaelmas term of 1910.

OXFORD.—The next award for the Radcliffe prize will be made in March, 1911. The prize, which is of the value of 50*l.*, is awarded by the master and fellows of University College every second year for research in any branch of medical science comprised under the following heads:—human anatomy, physiology, pharmacology, pathology, medicine, surgery, obstetrics, gynæcology, forensic medicine, hygiene. The prize is open to all graduates of the University who shall have proceeded or shall be proceeding to a medical degree in the University. Candidates must not have exceeded twelve years from the date of passing the last examination for the degree of B.A., and must not, at the date of application, be fellows on the foundation of Dr. John Radcliffe. The memoirs must be sent to the University Registry on or before December 1.

The Rolleston memorial prize, the value of which is 60*l.*, will be awarded in Easter or Trinity term, 1912. The prize is open to such members of the Universities of Oxford and Cambridge as will not have exceeded ten years from the date of their matriculation on March 31, 1912, and is to be awarded for original research in any subject comprised under the following heads:—animal and vegetable morphology, physiology and pathology, and anthropology, to be selected by the candidates themselves. Candidates wishing to compete should forward their memoirs to the registrar of the University before March 31, 1912. The memoirs should be inscribed "Rolleston Memorial Essay," and should each bear the name and address of the author. They may be printed or in manuscript, memoirs already published being admitted to the competition.

The electors have appointed Mr. Raphael Meldola, F.R.S., professor of chemistry in Finsbury Technical College, City and Guilds of London Institute, to deliver the Herbert Spencer lecture in the course of next Michaelmas term. No more appropriate selection could have been made than that of Prof. Meldola, whose wide range of scientific knowledge and interest, extending far beyond the bounds of his special subject, and whose well-known sympathy with everything which can tend to further the progress and popularise the results of physical and biological research, justify the expectation that his lecture will be of exceptional interest and value. The subject and date of the lecture will be announced later.

Mr. Selwyn Image, who has recently been elected to the Slade professorship of fine art, is well known to naturalists as a keen student and collector of the British Lepidoptera. He is a Fellow of the Entomological Society of London, and is at present serving on the council of that society.

The delegates of the common university fund propose shortly to appoint a reader in social anthropology.

At the tercentenary festival of Wadham College, held on June 23, allusion was made both by Lord Curzon and by Sir Archibald Geikie to the connection of the college with the early history of the Royal Society. The latter speaker gave it as his opinion that but for Dr. John Wilkins, the warden of Wadham, under whose auspices the Oxford meetings of "the association of certain worthy persons inquisitive in Natural Philosophy" (Walter) began about 1648 or 1649, the Royal Society might never have come into existence.

SHEFFIELD.—Dr. J. Robinson has been appointed junior lecturer and demonstrator in physics, and Mr. J. Miller assistant in the architectural department.

MR. H. S. JACKSON, research assistant in plant pathology at the Oregon Agricultural Experiment Station, has been appointed professor of botany and plant pathology in the Oregon Agricultural College.

THE Speech Day of the Merchant Venturers' Technical College, Bristol, will be Friday, July 22, when Colonel F. C. Ord, C.B., the master of the Society of Merchant Venturers, will distribute the prizes.

DR. H. S. JENNINGS, hitherto professor of experimental zoology at the Johns Hopkins University, has been appointed professor of zoology and director of the biological laboratory of the same University, in succession to the late Prof. W. K. Brooks.

THE Cleveland College of Physicians, now the medical department of Ohio Wesleyan University, is to be consolidated with the medical department of Western Reserve University at the close of the present college year. Mr. H. M. Hanna has given the sum of 50,000*l.* as an additional endowment fund for the medical department.

IT is announced in *Science* that two more industrial fellowships for the investigation of the diseases of plants (making four in all) have been established in the New York State College of Agriculture. They are to be known respectively as the Herman Frasch fellowship and the John Davey fellowship. The first-named provides for the investigation of the use of dry sulphur as a fungicide both to the plants and in the soil, and the second provides for the investigation of heart-rot of trees.

A NEW University for Natal is, says the *Westminster Gazette,* to be opened formally in August next. It is anticipated that a large number of students will be enrolled at once. Under the South Africa Act of Union the University will come under the jurisdiction of the Union Government, while education, other than higher education, will be vested in the Provincial Council for a period of at least five years. The Act establishing the University provides that instruction shall be given in classics, literature, law, science and art, and other studies. Designs for a handsome building have been approved by the Natal Government. Already Mr. W. N. Roseveare has been appointed professor of mathematics and Mr. Bews professor of botany and geology.

THE Rural Education Conference, which has been constituted by the Presidents of the Board of Agriculture and Fisheries and the Board of Education, for the discussion of all questions connected with education in rural districts, and for the periodical exchange of views between representative agriculturists and the two departments, will be composed as follows:—Lord Moreton, Lord Barnard, the Right Hon. Lord Belper, the Right Hon. Lord Reay, G.C.S.I., G.C.I.E., the Right Hon. A. H. Dyke Acland, the Right Hon. H. Hobhouse, Sir Francis A. Channing, Bart., M.P., Sir A. K. Rollit, Major P. G. Craigie, C.B., Mr. Graham Balfour, Mr. C. Bathurst, M.P., Mr. G. A. Bellwood, Mr. J. F. Blackshaw, Mr. W. F. Brockholes, Mr. G. G. Butler, Mr. A. W. Chapman, Mr. F. J. Chittenden, Mr. S. H. Cowper-Coles, Mr. D. Davies, M.P., Major J. W. Dent, Mr. H. J. Elwes, F.R.S., Prof. W. R. Fisher, Mr. P. Hedworth Foulkes, Mr. W. J. Grant, Mr. A. D. Hall, F.R.S., Mr. W. A. Haviland, Prof. C. Bryner Jones, Mr. T. Latham, Mr. J. L. Luddington, Mr. H. Martin, Mr. E. Mathews, Rev. R. Meyer, Mr. W. Parlour, Mr. C. N. P. Phipps, Mr. J. H. Sabin, Mr. A. F. Somerville, Prof. W. Somerville, Mr. A. E. Bromehead-Soulby, Mr. C. Turnor, Mr. F. Verney, M.P., Prof. T. Winter, and Prof. T. B. Wood. The Right Hon. H. Hobhouse will act as chairman of the conference, and Mr. E. G. Howarth, of the Board of Education, and Mr. H. L. French, of the Board of Agriculture and Fisheries, will act as joint secretaries.

ON May 28, at the Regent Street Polytechnic, London, Mr. Blair (education officer to the London County Council) gave an address on "The Newer Education" to the members of the Federated Associations of London Non-primary Teachers. Mr. Blair said that the adverse criticisms sometimes passed on the results of modern elementary education arise from ignorance of the progress that has really been made in this direction during the last fifty years. There is now hardly an illiterate person in the country, and, moreover, the facts that crime has decreased, that sanitary conditions have improved, that the death-rate has fallen, and that the funds of savings banks and provident societies show a steady increase, must all be attributed indirectly to the work done in elementary schools. We were in this respect far ahead of Germany. An important part of the recent work of the London County Council has been the institution of its scheme of scholarships for children fit to pass from the elementary to the secondary schools. The full development of this scheme is yet to come, for there is a distinct need that the child, leaving the secondary school at the age of sixteen and not wishing to take up elementary-school teaching, shall have some course of definite technical training. So far as wage-earning capacity is concerned, boys and girls leaving secondary schools at this age are in no better position than children leaving the elementary schools at the age of fourteen. After reading certain examiners' reports referring to the unsatisfactory work in some secondary schools, Mr. Blair stated that there is still a tendency for this work to be too academic in character, and he urged that secondary-school teachers must strive to correlate their teaching with the facts of life, and remember that upon them falls a large part of the responsibility for training the child for its future duties as a citizen of the Empire. Some statesmen consider that before long we may be called upon to meet a serious national emergency, and the way in which we shall do this will depend on the work of the teachers both in the elementary and in the secondary schools.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 23.—Mr. A. B. Kempe, vice-president and treasurer, in the chair.—A. **Mallock**: Damping of sound by frothy liquids. The object of the note is (1) to explain the well-known fact that a vessel which, when empty or filled with a homogeneous liquid, gives a musical note when struck, ceases to do so when the liquid contains bubbles of gas; (2) to direct attention to the fundamental difference between the damping of waves propagated through a gas containing spheres of liquid (*e.g.* rain or fog), and that which occurs in a liquid containing bubbles of gas. The damping of sound waves by fog has received considerable attention, and it has been shown that although

presence of liquid particles does cause a certain amount of dissipation, loss of energy is small, and this agrees with observation. On the other hand, with a liquid containing bubbles, damping of vibration is excessive, practically the whole of the wave energy being dissipated in a few wave-lengths or periods. When spheres of liquids are disseminated in a gas, compressions and dilatations take place in the latter much as if only the gas were present, and the increased dissipation is due to slight modification in the motion of the gas, brought about by the liquid spheres. In the converse case, when bubbles of gas are disseminated through a liquid, variation of volume consequent on the passage of a wave takes place almost entirely in the gas, and distortion of the liquid about the bubbles of whose volume is the variable introduces a rate of dissipation of a different and larger order. It is pointed out that in a mixture of liquid and gas (in the form of bubbles) the velocity of wave propagation is less than that in either constituent alone, and has a minimum when the proportion of gas to liquid has a certain value. If the mixture consists of air and water, minimum velocity of propagation is reached when the volumes of air and water are nearly equal, and is then about one-fourteenth the velocity of sound in air. When the volume ratio of gas to liquid exceeds a certain limit, depending on the order in which the bubbles are arranged, the latter cannot remain spherical, and the mixture then becomes a froth, or collection of air cells separated by thin liquid walls. It is shown by experiment that such froth is a very effective agent in damping vibrations.—Prof. P. V. **Bevan**: The dispersion of light by potassium vapour. The work described in this paper was an attempt to measure quantitatively the amount of dispersion in the vapour of potassium. Dispersion takes place in the vapour chiefly on account of the red absorption lines, but is also to a smaller extent due to other lines of the principal series. Measurements were made showing dispersion affected by the first six pairs of lines of the principal series, and an effect could just be detected at the next pair of lines. The dispersion was found to fit a Sellmeier formula, and values for four of the constants for this formula were obtained. On theoretical grounds we can conclude, from the relative values of the constants of the dispersion formula, that the number of atoms taking part in the absorption of the light after the first pair of lines must be only a small fraction of the total number present in the vapour, and that this fraction decreases with the number of lines in the series. It is suggested that the explanation of series lines must therefore be looked for in systems which are not the atom pure and simple, but probably atoms to which a corpuscle or more than one corpuscle become attached. Several types of quasi compounds may thus be formed in a way suggested by Sir J. J. Thomson, and the periods commonly associated with the atoms may be the periods of these systems. Our conception of the atom may be thus considerably simplified, as the number of degrees of freedom for each individual atom may be diminished very largely if this view be the true one.—J. W. **Gifford**: Additional refractive indices of quartz, vitreous silica, calcite, and fluorite.—J. Ivon **Graham**: The absorption spectra of sulphur vapour at different temperatures and pressures, and their relation to the molecular complexity of this element. The absorption spectra were photographed at temperatures varying from 530° C. up to 900° C., at atmospheric pressure, and at constant temperatures, under pressures between atmospheric and 10 mm. of mercury. The photographs at constant pressure with the above variation of temperature show the presence of two distinct absorption spectra; these are attributed to the intramolecular vibrations of the S_8 and S_2 complexes respectively, the former producing a series of absorption bands between $n\,(=\lambda^{-1})$ 2000 and n 2600, with mean position of maximum absorption about n 2500, whilst the relatively lighter S_2 molecular system, by taking up vibrations of greater frequencies, produces a series of bands lying between n 2900 and n 3820, with mean position of maximum absorption about n 3750. Since *only two* distinct spectra are evident, it is concluded that the equation $S_8=4S_2$ represents the sole reaction that occurs in the dissociation of sulphur vapour on heating from its boiling point up to 900° C. The interpretation of the photographs of the absorption spectra of the vapour at different (constant) temperatures, but with reduction of pressure, indicates that above 580° C. the dissociation of the molecule S_8 is simple, that is, there is direct dissociation into S_2 complexes, but at or below 520° C. the dissociation takes place with the formation of molecules intermediate in complexity between the above two aggregates. The position of maximum absorption of each band is towards the more refrangible edge, whilst the individual bands of each series appear to become stronger, also in the more refrangible direction. The two series of bands are shown mapped in oscillation frequencies, the similarity between the series being much more evident when illustrated in this manner. Reproductions of photographs also accompany the paper.—Dr. T. H. **Havelock**: The wave-making resistance of ships: a study of certain series of model experiments. In a previous paper (Proceedings, A, vol. lxxxii., p. 276, 1909) the author discussed the variation of the wave-making resistance of a ship with its speed, and a formula was obtained by specifying the action of a ship in terms of a simple equivalent pressure distribution travelling over the surface. The present investigation is a more systematic study of some of the coefficients of the formula, the experimental data being taken from published records of tank experiments with models. The discussion is limited to types for which the resistance-velocity curve shows clearly the humps and hollows which are usually ascribed to interference of wave systems originating at the bow and stern; the tabulated results form a numerical study of the latter theory, and exhibit the variation of the coefficients of the simple equivalent pressure system with the displacement of the model, the proportion of parallel middle body, and various coefficients of fineness. Without attempting to express the coefficients by empirical formulæ, sufficient information is available to allow of an approximate estimate of their values in similar models; this is illustrated by the *Turbinia*, and the result is discussed in relation to the published record of trials of that vessel. The characteristic interference effect mentioned above appears to occur specially in rather full-ended models, with fairly high cylindrical coefficients; in this case it is permissible to regard the equivalent pressure system as having two parts associated with the bow and the stern respectively. An examination of models with finer ends suggests that this simple interference theory is inadequate in certain cases; the study of a modified type of pressure distribution is indicated.—Dr. Georges **Dreyer** and W. **Ray**: The blood volume of mammals as determined by experiments upon rabbits, guinea-pigs, and mice, and its relationship to the body weight and to the surface area expressed in a formula. The blood volume of animals has for many years been the subject of numerous investigations. This is but natural considering its great importance for the study of disease. As, however, the results obtained are very discordant, the authors have determined the blood volumes of rabbits, guinea-pigs, and mice by Welcker's method, by washing out the circulatory system and by following the percentage fall of hæmoglobin after bleeding. The experiments of the authors have given the following results:—(1) The blood volume of living mammals can be determined very accurately by bleeding the animal (about 20 per cent. of its original blood volume) and determining the percentage fall of hæmoglobin at the moment when equilibrium is reached. This method gives results remarkably concordant with those obtained by washing out the circulatory system. In employing this method it is absolutely essential that the animals should not have been bled before. (2) In normal healthy mammals (rabbit, guinea-pig, and mouse) the blood volume is satisfactorily expressed by the following formula, $B=W^{\frac{2}{3}}/k$, where B is the blood volume in cubic centimetres, W the weight of the individual in grams, and k a constant to be ascertained for each particular species of animal. This formula indicates that the smaller animals of any given species, which have a relatively greater body surface than heavier ones, have also a relatively greater blood volume. That is to say, the blood volume can be expressed as a function of the surface area. It is therefore misleading to express the blood volume as percentage of the body weight, as has hitherto been invariably done. (3) The constant k, by means of which the blood volume in cubic centimetres can be calculated from the formula $B=W^{\frac{2}{3}}/k$ when the weight of the animal in grams is known, is approximately,

for rabbit, 1·58; guinea-pig, 3·30; mouse, 6·70.—E. C. **Hort**: Autotoxæmia and infection. The object of this communication is to show that fever, loss of weight, and changes in the antitryptic values of the blood serum, three phenomena common to bacterial and protozoan infection in man, can be reproduced in animals by the subcutaneous injection of small quantities of distilled water. Elaborate controls were set up throughout, and absence of sepsis repeatedly proved by autopsy and by microscopical sections. *Fever.*—Sixty guinea-pigs received single injections of boiled distilled water in quantities varying from 1 to 10 c.cm. Fever resulted in fifty. Thirty guinea-pigs received multiple injections, always followed by fever except when the injections were too closely crowded, or too large, when subnormal temperatures resulted. Twelve rabbits received single injections varying from 10 to 60 c.cm. Fever followed in all. Ten rabbits received multiple injections. All showed fever. Fever after each injection was always rapid in onset, abrupt and fugitive in both guinea-pig and rabbit. By appropriate spacing of injections continuous fever can be produced, ceasing with the injections. Hypersensitisation was frequently observed. Establishment of a constant between weight of injection, animal injected, and degree of fever induced has been so far impossible. *Weight.*—The effect of small single injections was inconclusive. Multiple injections always produced marked loss, recovery ensuing on discontinuance of injections if few in number. *Antitryptic values.*—Multiple injections produced marked rise in values, strikingly parallel in gross effect to the rise produced in the same species of animal by single injections of diphtheria toxin, or of emulsions of living bacteria. From these experiments it would appear that however great the share taken by bacteria and protozoa in initiating the disease-complex of infection, the net result is, perhaps to a large extent, a state of true auto-intoxication. The results obtained suggest that such auto-intoxication is in part directly due to absorption of derivatives of the infected cells themselves, and only indirectly to the absorption of bacterial products.

Physical Society, June 10.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Dr. W. E. **Sumpner** and W. C. S. **Phillips**: A galvanometer for alternate-current circuits. The galvanometer described is the result of an attempt to construct a measuring instrument by means of which inductances and capacities can be compared by bridge methods as accurately as it is possible to compare resistances. The instrument is like a moving coil galvanometer in almost every respect, except that its field is due to a specially constructed electromagnet excited by an alternating voltage.—A. E. **Garrett**: Positive electrification due to heating aluminium phosphate. Many of the results obtained, in particular (*a*) with varying pressures and constant temperatures, (*b*) at atmospheric pressure in which after removal of all free ions by a field sufficient to produce a saturation current, a current of equal values for ions of both signs was found at an electrode placed behind that on which the saturation voltage acted, and (*c*) the loss of charge of a Faraday cylinder when screened from the action of free ions, indicate that one of the products due to heating aluminium phosphate is in the form of neutral pairs or doublets which afterwards split up into negative and positive ions.

Royal Anthropological Institute, June 14.—Prof Gowland, past-president, in the chair.—P. A. **Talbot**: The Ekoi of southern Nigeria. The Ekoi dwell by the border of the German Kamerun. Their land, between its maze of rivers, is one stretch of dense "bush," whch reaches even to the summit of the hills, of which the greater part of the country consists. The whole existence of the race mirrors the twilight and mystery of the bush, peopled to the native's fancy by strange, half-human shapes, such as were-leopards and the genii of trees and rocks. Magic is the keynote on which the lives of the Ekoi turn. Idiong, the practice of divination, is much resorted to, and is clearly connected with ancestor worship, the dominant factor in the religion of the race. The great festival of the year is that of Eja, held at the time of the new yams. Investigations have proved that these rites are almost identical with many of the darker traits of the old Adonis-Attis-Osiris worship. Many beliefs and customs of the Ekoi have come down from remotest antiquity. They have a marvellous folklore, which at times shows poetic feeling, at others a keen sense of humour. There are legends to explain all customs and beliefs. The land is full of societies, secret and otherwise, the chief of which is the Egbo Club, which ruled the country before the coming of the white man. Though a polygamous people, the chief wife, not the husband, is the head of the house, and women's rights as to property and the custody of children are most strictly safeguarded by native law.

Zoological Society, June 14.—Dr. S. F. Harmer. F.R.S., vice-president, in the chair.—R. I. **Pocock**: The cutaneous scent-glands of ruminants. The author pointed out that the structure of the feet, whether furnished with special glands or not, supplied valuable data for classifying the genera of antelopes and deer, and showed that with some modifications, such as the removal of Tetraceros from the Cephalophinæ to the Tragelophinæ, of Dorcotragus from the Antilopinæ to the Neotraginæ, and of Pantholops, Saiga, and Æpyceros from the Antilopinæ, the subfamilies usually admitted were valid groups. In the case of the deer, it was interesting to note that Rucervus, Panolia, Elaphurus, and Sika were closely allied to Cervus, Dama being a totally distinct type. Axis and Hyelaphus belonged to another group, while Rangifer, Alces, and Capreolus, as Sir Victor Brooke claimed, belonged to the section typified by Dorcelaphus, Mazama, and other American deer.—R. **Lydekker**: A wapiti and a muntjac. The author described two wapiti antlers from Tibet as *Cervus canadensis wardi*, and a muntjac from An-wei, China, as *Cervulus bridgemani*. The latter was characterised by its dark blackish-olive colour, the black ears of the female and the yellow ones of the male, coupled with the relatively wide divergence of the antler-pedicles.—R. **Lydekker**: Three African buffaloes.—Dr. A. **Cabrera**: Two new antelopes. The author described a new species of Damaliscus from British East Africa and a new chamois from north Spain.—Dr. E. A. **Wilson**: Changes of plumage in the red grouse (*Lagopus scoticus*) in health and disease.

PARIS.

Academy of Sciences, June 20.—M. Émile Picard in the chair.—H. **Deslandres**, L. **d'Azambuja**, and V. **Burson**: An extraordinary solar filament. A detailed account, with reproductions from photographs, of a filament which appeared on April 11. It had the peculiarity of having large radial velocities, mostly ascending, which at certain points exceeded 100 kilometres per second. The solar disturbance of April 11 was not apparently accompanied with terrestrial magnetic disturbances.—J. **Boussinesq**: The principles of mechanics and their applicability to phenomena which appear to contradict them.—E. **Bouty**: A new measurement of the dielectric cohesion of argon. The determination of the dielectric cohesion of argon is attended with difficulties which do not arise in the case of the other rare gases. For a fixed pressure, for no apparent cause, there are progressive variations in the minimum difference of potential capable of causing the discharge. By making two consecutive measurements rapidly at widely different pressures this difficulty is partly got over. The cohesion of argon was finally found to be practically double that of helium. the gas immediately preceding it in the periodic table.—A. **Chauveau** and M. **Contejean**: The elimination of nitrogenous waste in the act of renal secretion, the subject having been deprived of food. The relation between this elimination and that of water, the vehicle of the urinary excreta. The reciprocal independence of the two phenomena. The amounts of water and urinary nitrogen excreted in the young subject are independent, and hence variations in the quantity of urine secreted, in the course of a series of experimental periods, introduce no difficulties in the significance of the nitrogenous excreta carried away by the urine.—M. **Gouy**: The mutual action of two kathodes in the magnetic field. In high vacua, when the negative charges are connected by the lines of magnetic force, they produce an action of unknown nature, which is shown by a marked lowering of the explosive potential and by the production of the inter-kathodic light.—M. **Nicolau**: The variation in the motion of the moon.—Edmond **Bauer** and Marcel **Moulin**: The luminosity of

the sun and the solar constant. A description of a new method of determining the constant in Stefan's law.—J. Comas **Solà**: A *résumé* of physical observations made on Halley's comet.—E. **Vessiot**: The integration of complete systems.—M. **Hadamard**: Some properties of Green's function.—Paul **Renard**: A method of causing an aëronef to pursue a rectilinear path with a minimum expenditure of total work.—B. **Szilard**: An action at a distance on the coherer produced by metallic contacts. Instead of putting one extremity of the coherer to earth, as usual, it is connected with one pole of an alternating current, the other pole being earthed. In this way the sensibility of the coherer is greatly increased, and some applications of the modified coherer are described.—F. **Croze**: The prolongation of the band spectra of carbon gases in the extreme red and infra-red. For carbon monoxide photographs in the infra-red show several bands resembling the bands already known in their structure, and occupying very closely the place predicted according to the known law of distribution. The results with cyanogen were similar.—Ch. **Fabry** and H. **Buisson**: Some electrical and spectroscopic properties of the arc between metals.—G. **Sagnac**: An interferometer with superposed inverse light rays giving in polarised white light a narrow central fringe and narrow coloured fringes with white interspaces.—Louis **Dunoyer**: A method of measuring a magnetic field in magnitude, direction, and sense.—L. **Houllevigue**: The formation of kathodic deposits. The walls upon which the metallic deposit forms are those possessing a positive charge, allowing the electrical neutralisation of the kathode granules.—A. **Perot**: Some peculiarities of the mercury arc in a vacuum. A study of the distribution of the fall of potential in the arc, together with the demonstration of the existence of an extra pressure at the anode.—E. **Baud** and L. **Gay**: The temperature of crystallisation of binary mixtures. On the basis of certain assumptions, the lowering of the freezing point is shown to be proportional to the logarithm of the molecular concentration and to the absolute temperature of crystallisation. For very dilute solutions this is equivalent to Raoult's formula. Experimental proofs of the logarithmic formula are given.—Daniel **Berthelot** and Henry **Gaudechon**: The photochemical synthesis of carbohydrates at the expense of the elements of carbon dioxide and water vapour in the absence of chlorophyll. The photochemical synthesis of quaternary compounds. Various gaseous mixtures were exposed to the action of the rays from a mercury vapour lamp. Carbon dioxide was obtained at the ordinary temperature from a mixture of oxygen and carbon monoxide. Carbon dioxide and hydrogen gave a little CO and formaldehyde; no trace of acid was formed in this reaction. Formamide was produced in the same way from ammonia and carbon monoxide.—G. **Austerweil** and G. **Cochin**: Some relations between molecular constitution and smell.—E. **Léger**: Crystallised aloinose and its identity with *d*-arabinose.—H. **Arsandaux**: A new contribution to the study of the laterites.—Raoul **Combes**: The best illumination for the development of plants.—V. **Pachon** and Em. **Perrot**: The cardio-vascular action of green coffee compared with that of corresponding doses of caffeine. The action noted is due to some other agent than caffeine.—A. **Magnan**: The influence of the alimentary *régime* on the intestine in birds.—G. **Seliber**: The coloration of the pigment in two fungi.—A. **Étard** and A. **Vila**: The analysis of protoplasmic materials. A discussion of the various group reagents which may be used for the separation of the substances present in the liquids resulting from the hydrolysis of protoplasmic materials.—M. **Noel**: The infiltrations on the *massif* of Zaghouan (Tunis).

DIARY OF SOCIETIES.

THURSDAY, JUNE 30.

ROYAL SOCIETY, at 4.30.—A New Method for the Quantitative Estimation of Hydrocyanic Acid in Vegetable and Animal Tissues: Dr. A. D. Waller, F.R.S.—On the Structure, Development, and Morphological Interpretation of the Pineal Organs and Adjacent Parts of the Brain in the Tuatara (*Sphenodon punctatus*): Prof. A. Dendy, F.R.S.—On the Scattering of Homogeneous β-Rays, and the Number of Electrons contained in the Atom: J. A. Crowther.—On the Spontaneous Crystallisation and the Melting and Freezing Point Curves of Mixtures of Two Substances which form Mixed Crystals and possess a Minimum or Eutectic Freezing Point. Mixtures of Azobenzene and Benzylaniline: Miss F. Isaac.—On the Determination of the Chief Correlations between Collaterals in the Case of a Simple Mendelian Population Mating at Random: E. C. Snow.—The Propagation of Sound in a Fog: C. J. T. Sewell.—A Determination of the Ratio of Mass to Weight for a Radioactive Substance: L. Southerns.—The Relative Atomic Weights of Nitrogen and Sulphur: F. P. Burt and F. L. Usher.—The Relation of Light Perception to Colour Perception: Dr. F. W. Edridge-Green.—The Anatomy and Morphology of the Leaves and Inflorescences of *Welwitschia mirabilis*: Miss M. G. Sykes.—And other papers.

FRIDAY, JULY 1.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of West Yorkshire, with Special Reference to the District to be Visited during the Long Excursion: Prof. P. F. Kendall.

FRIDAY, JULY 8.

PHYSICAL SOCIETY, at 5.—A Thermo-electric Balance for the Absolute Measurement of Radiation: Prof. H. L. Callendar, F.R.S.—The Convection of Heat from a Body cooled by a Stream of Fluid: Dr. Alexander Russell.—On Hysteresis Loops and Lissajous' Figures, and on the Energy wasted in a Hysteresis Loop: Prof. S. P. Thompson, F.R.S.—The Energy Relations of certain Detectors used in Wireless Telegraphy Dr. W. H. Eccles.

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